2.6.5.1.2 Description of Wet Storage Facilities

A wet storage facility consists of a spent nuclear fuel storage area and support areas (Dahlke et al., 1994). The spent nuclear fuel management area would provide for the receipt of cask transport vehicles, cask unloading and decontamination, and spent nuclear fuel handling, transfer, and storage. Support areas would provide for the equipment necessary to maintain and operate the storage area (e.g., heating, ventilating, and air conditioning; water treatment; and waste management). The general layout of a wet storage facility is presented in Figure 2-10. The wet storage facility would be constructed as a safety class structure that meets all current nuclear regulations to withstand natural events such as seismic activity, tornadoes, and floods, as well as aircraft impact. Systems supporting the operation of the spent nuclear fuel management facility would also be required to meet these safety requirements. The facility would be equipped with a 118-metric ton (130-ton) overhead crane and a 9-metric ton (10-ton) spent nuclear fuel handling crane. Figure 2-11 displays a schematic of the facility, and Table 2-10 summarizes wet storage parameters for foreign research reactor spent nuclear fuel handling and storage.

Each cask transport vehicle would enter the facility through one of two bays where it would be monitored and washed to remove transportation dust. When the external surfaces are cleaned, the cask would be placed into a decontamination room where the cask would be prepared as needed to facilitate underwater unloading. The cask would then be placed in an unloading pool. The cask receiving area can accept two simultaneous shipments on 3 m by 24.4 m (10 ft by 80 ft) trucks or railcars, and casks weighing up to 114.3 metric tons (126 tons) each with a total individual cask and transport vehicle weight of 176 metric tons (195 tons). There are two unloading pools [6.1 m long and wide by 11.0 m deep (21 ft long and wide by 36 ft deep) and 6.4 m long by 5.8 m wide by 13.4 m deep (21 ft long by 19 ft wide by 44 ft deep)] and two decontamination rooms. Prior to being placed in one of the two storage pools, each fuel element would be checked to ensure that it is properly configured for direct transfer to the fuel storage pool buckets. If not, it would be transferred to the fuel cutting/canning pool [10.4 m long by 5.8 m wide by 9.4 m deep (34 ft long by 19 ft wide by 31 ft deep)] where it would be prepared for transfer to the storage pool buckets.

If cask measurements indicated that the spent nuclear fuel might be leaking, the spent nuclear fuel would be transferred to the isolation pool [3.7 m long by 3.0 m wide by 9.4 m deep (12 ft long by 10 ft wide by 31 ft deep)] for sipping. Sipping is a methodology for determining leaking spent nuclear fuel. This pool would be equipped so that wet sipping, dry sipping, or vacuum sipping of the suspect spent nuclear fuel element could be performed. An identified leaking spent nuclear fuel element would then be transferred to the cutting/canning pool where it would be canned before transfer to one of the storage pools. If it was not found to be leaking, it would be transferred directly to a storage pool.

All six pools in this facility (two unloading, two storage, one cutting/canning, and one leak check/isolation) would be hydraulically connected by a transfer channel/pool which would be 6.1 m long by 3.3 m wide by 9.4 m deep (20 ft long by 11 ft wide by 31 ft deep). Gates between this transfer channel and each pool would allow for hydraulic watertight isolation of the other pools. All pools and channels would be constructed of concrete with stainless steel floors and liners. Pool water leak detection and collection systems in accordance with NRC Regulatory Guide 1.13 (NRC, 1975) and American National Standards Institute, Standard N305-1975 (ANSI, 1975) would be provided for the pools.

Each of the two storage pools would be 16.5 m long by 10.4 m wide by 9.4 m deep (54 ft long by 34 ft wide by 31 ft deep), and each would contain 40 stainless steel storage racks. This would provide 1,000 storage holes with a 20 cm (8 in) spacing maintained between adjacent holes. The 20 cm (8 in) space provides neutron isolation between adjacent spent nuclear fuel elements, and would ensure criticality safety. Each rack would be 2.0 m square and 3.2 m high (6.7 ft square and 10.5 ft high) and consist of a

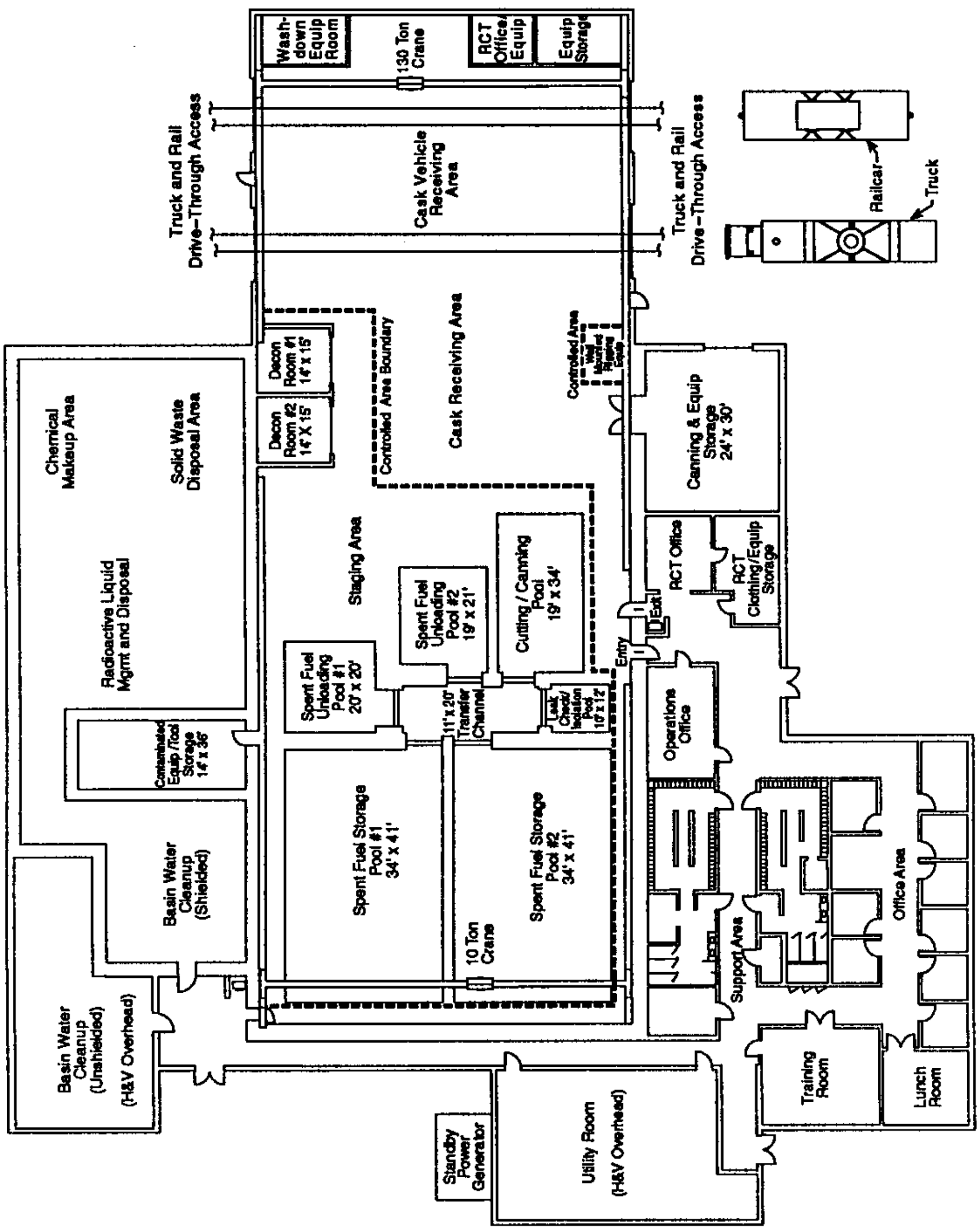


Figure 2-10 Generic Wet Storage Facility for Foreign Research Reactor Spent Nuclear Fuel

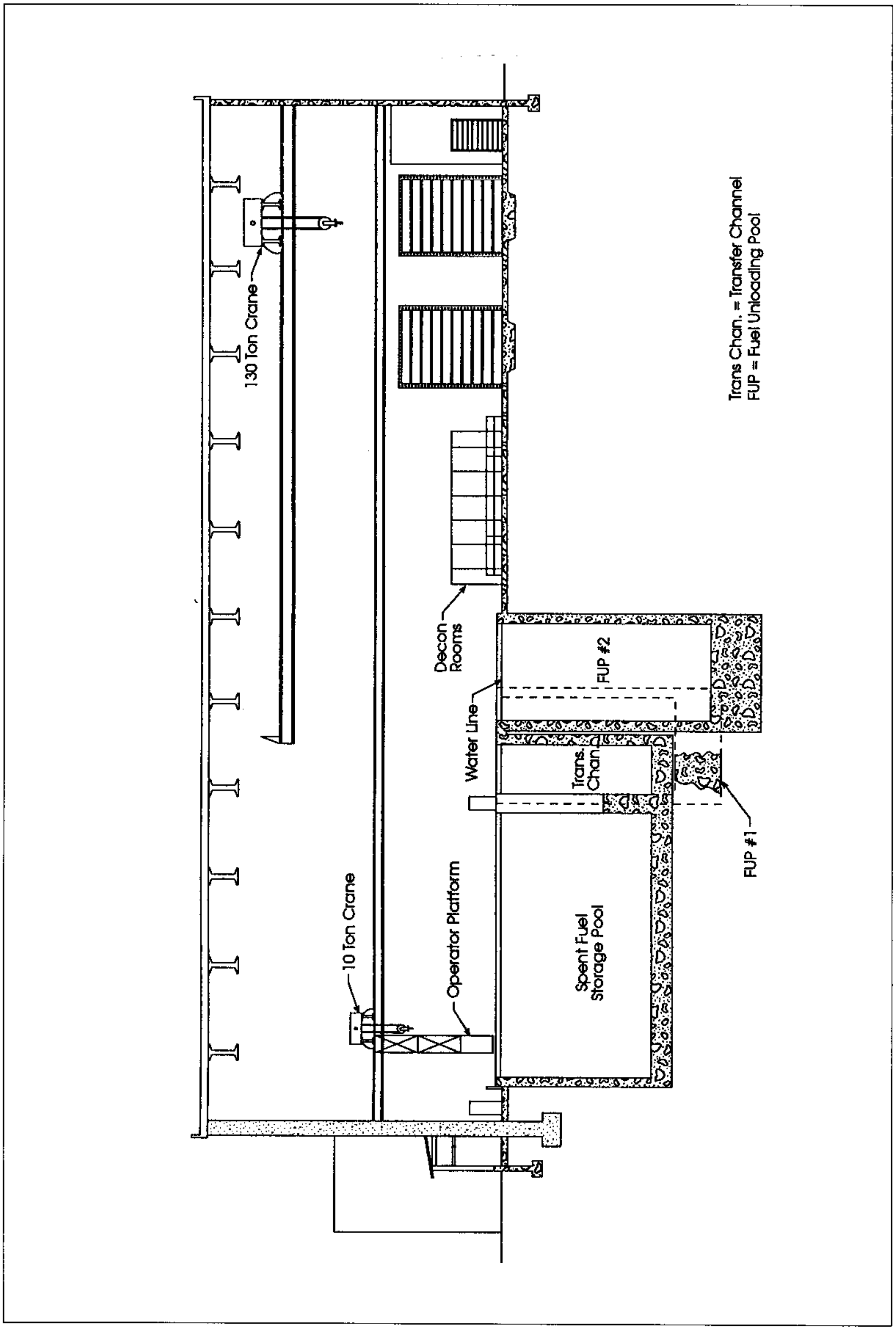


Figure 2-11 Schematic of a Wet Storage Facility for Foreign Research Reactor Spent Nuclear Fuel

Table 2-10 Summary of Wet Storage Parameters for Foreign Research Reactor Spent Nuclear Fuel

Construction Phase:	
Disturbed Land Area	2.8 ha (7 acres)
Facility: size (area) concrete steel	 3,800 m^2 (41,000 ft^2) 12,400 m^3 (16,260 yd^3) 3,100 metric tons (3,443 tons)
Soil Moved	18,000 m^3 (24,000 yd^3)
Equipment Fuel	600,000 l (159,000 gal)
Construction Debris/Waste	2,600 m^3 (10,300 yd^3)
Work Force	157/yr (average), 184 peak
Duration (years)	4 years for construction, 1.5 years for design
Cost	$449 million[a,b]
Operation Phase:	
Electricity	1,000 - 1,500 MW-hr/yr
Water (liters)	2.7 million l/yr (720,000 gal/yr) during receipt 1.5 million l/yr (409,000 gal/yr) thereafter
Waste Streams:	
High-Level Waste	none
TRU	none
Solid Low-Level Waste	16 m^3/yr (580 ft^3/yr)
Waste Water	1.59 million l/yr (420,000 gal/yr) during receipt 0.4 million l/yr (109,000 gal/yr) thereafter
Staff (Full-Time Equivalents)	30
Annual Cost	$23.3 million during handling, $3.5 million during storage[b]

[a] *Cost estimates are in 1993 dollars (EG&G, 1993)*

[b] *The cost may include duplicate facilities and equipment present in both the staging and the rest of the wet storage facility.*

5 by 5 array of 25 spent nuclear fuel positions. A hinged lid would be above each of these spent nuclear fuel positions. Spent nuclear fuel elements would be stored in the racks so that at least 30 cm (12 in) of rack would protrude above the top of the fuel. Each position in the rack can hold up to three storage buckets, which would be stacked vertically on top of each other. The bucket, made up of 3.175 mm (0.125 in) thick stainless steel, would be fitted with ceramic spaces to prevent galvanic corrosion, and could store either two or four spent nuclear fuel elements, depending on the specific fuel design. This would provide a total capacity of approximately 12,000 elements for each storage pool.

The heating, ventilation, and air conditioning system for the wet storage facility would include a room of air supply equipment and a room for air exhaust equipment with separate filtering and monitoring. All exhaust air would be directed through pre-filters, high-efficiency particulate air filters, radiation monitors, filter fire protection components, and heat recovery coils before it would exhaust to the atmosphere.

The wet storage facility's water treatment system would consist of redundant pumps, piping, filters, deionizers and microorganism control systems. A heat removal system would be sized to maintain the bulk water temperature to acceptable levels. The system's filters and deionizers would include anion and cation exchangers that maintain water chemistry and remove radionuclides from the pool water.

The staff required to operate the wet storage facility would be a maximum of 30 when 24-hour-a-day fuel loading was being performed.

No high activity solid radioactive waste would be generated by the wet storage facility (equivalent to Class B or C low-level waste) over the life of the facility. Low-level solid radioactive waste that would be generated over the life of the facility would be about 640 m^3 (22,600 ft^3). Nonradioactive solid waste generated over the facility's life would be about 300 m^3 (10,600 ft^3). All ventilation air would pass through roughing and high-efficiency particulate air filters prior to exhaust. No nonradioactive, hazardous air emissions would be generated by this facility.

The cost to construct a wet storage facility with a staging area sufficient to unload, characterize, can, and transfer the spent nuclear fuel to the storage area is estimated to be $449 million. This cost may include some duplicate facilities and equipment present in both the staging facility and the rest of the wet storage facility which were costed separately. The annual operating cost for this facility is estimated to be $23.3 million during the period of handling the spent nuclear fuel and $3.5 million during the period of storage. The cost estimate for the facility is based on a cost report prepared by Idaho Inc. (EG&G, 1993).

2.6.5.2 Chemical Separation

Chemical separation involves separating the fissile material in the spent nuclear fuel from the other material (i.e., cladding material, fission products, etc.). Uranium and plutonium isotopes constitute the fissile materials; and with foreign research reactor spent nuclear fuel, relatively little plutonium and actinide elements are produced because the ^{238}U precursor is present in relatively small quantities. Waste materials would be mainly fission products (radioactive species such as cesium and strontium) in the form of liquid raffinates, low-level radioactive wastes, mixed radioactive/chemical wastes, waste acids, chelating and complexing agents, and organic solvents. The highly radioactive nature of fission products would require that the chemical separation activities be performed. Plutonium can be handled in facilities without radiation shielding, although these materials would still have to be handled under special procedures and precautions due to their radioactive, fissile nature. The other waste forms would require specialized handling, including volume reduction in some cases, to allow for safe storage and disposal.

Aqueous chemical methods are the only processing method applied on a large scale. All existing plants use an extraction process, which has been used for some 40 years. The spent nuclear fuel is initially dissolved in an acid and contacted with an organic solvent containing an extractant, such as tributylphosphate. The uranium and plutonium form a complex with the tributylphosphate and transfer to the organic phase. The cladding and waste materials remain in the aqueous phase, which is termed high-level waste. The uranium and plutonium are subsequently recovered by contact of the organic phase with weak acidic solutions. Vitrification of the high-level waste is the preferred waste management approach.

As discussed in Section 2.2.2.6 chemical separation is not a preferred technology for managing spent nuclear fuel in the United States.

Processing facilities exist at several DOE and foreign sites. The main domestic facilities are located at the Savannah River Site and Idaho National Engineering Laboratory. The main foreign facilities are in France and the United Kingdom.

Savannah River Site Facilities

At the Savannah River Site, two facilities are available to chemically separate the foreign research reactor spent nuclear fuel. These facilities are the F- and H-Canyons. The F- and H-Canyon facilities are nearly identical structures that use similar radiochemical processes for the separation and recovery of plutonium, neptunium, and uranium isotopes. The F-Canyon primarily recovered ^{239}Pu and ^{238}U from irradiated natural or depleted uranium, and the H-Canyon primarily recovered ^{238}Pu, ^{237}Np, and ^{235}U from irradiated reactor fuels and targets. The following paragraphs apply to both canyons unless noted.

The F- and H-Canyons are reinforced concrete structures, 255 m long by 37 m wide, and 20 m high (836.6 ft by 308 ft by 121.4 ft). They are named for the two areas ("canyons") in each structure that house the large equipment (tanks, process vessels, evaporators, etc.) used in the chemical separations processes performed in each facility. These areas are 170 m long by an average of 6 m narrow and 20 m deep (557.7 ft by 19.7 ft by 65.6 ft). The two canyons are parallel and open from floor to roof. A center section, which has four floors or levels, separates the canyons. The center section contains office space, the control room for all facility operations, chemical feed systems, and support equipment such as ventilation fans. Processing operations involving high radiation levels (dissolution, fission product separation, and high-level radioactive waste evaporation) occur in the "hot" canyon, which has thick concrete walls to shield people outside the facility and in the center section from radiation. The final steps of the chemical separations process, which generally involve lower radiation levels, occur in the "warm" canyon. Figure 2-12 shows the layout of F-Canyon.

Services typical for a large industrial facility are required to support the canyon operations. Such services include steam and cooling water for process vessels and a ventilation system.

A separate ventilation system serves portions of the facility, such as the hot and warm canyons, that contain the radioactive process equipment. This system ensures that the air pressure in such areas is below the pressure of the air outside the facility and the area occupied by workers. This design helps prevent the release of radioactive material outside the facility by ensuring that air always flows from the outside of the facility to the inside of the process areas. Air in the process areas is exhausted from the facility through a large filter that removes 99.5 percent of any airborne radioactive material from the air. A 61-meter-tall (200-ft) stack behind each canyon discharges this air to the atmosphere. This stack is the pathway for airborne emissions associated with the normal operation of the canyons.

Even though DOE has maintained the chemical separation facilities since their construction, they contain equipment and systems that have become degraded because of their age and changes in mission. In some cases the degraded condition of equipment can pose operational limitations. For example, at one time the H-Canyon contained equipment that provided the capability to dissolve not only aluminum-clad reactor fuel but also fuel clad in stainless steel. The electrolytic dissolver used for this purpose is no longer functional and has been abandoned in place.

Because of the ages of the facilities, they do not satisfy all current DOE requirements for the design and construction of nuclear facilities. For example, the canyons and associated B-Line facilities were built (during the Cold War when a primary concern was the potential for an attack) to resist a large external blast. The blast-resistant features of the canyons also make them resistant to such external natural phenomena as tornadoes and earthquakes. However, the canyons were not designed to withstand a severe earthquake (defined as producing a lateral ground acceleration that is 20 percent that of gravity or 0.2 g), as they would be if DOE were to build them today.

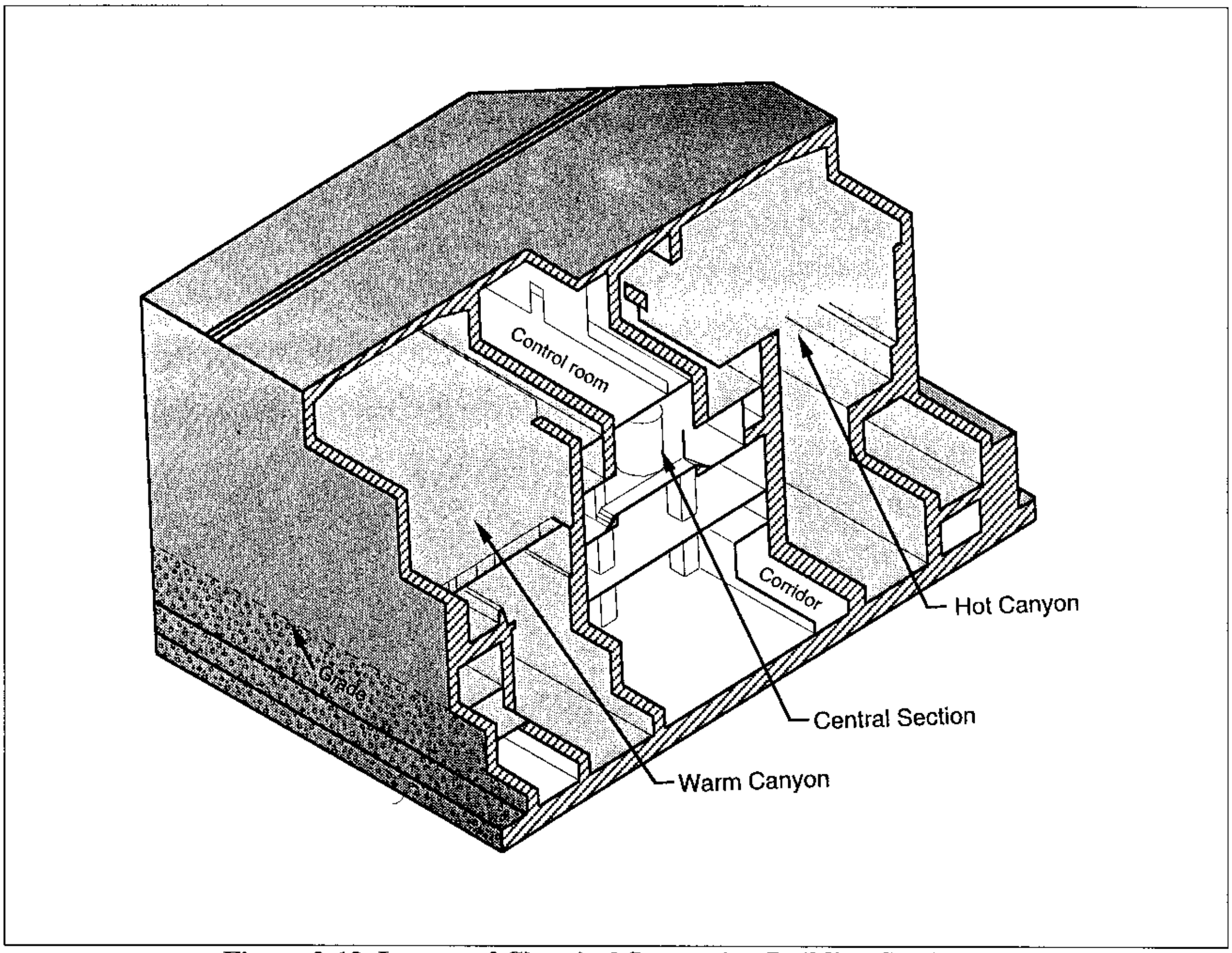


Figure 2-12 Layout of Chemical Separation Building Sections at Savannah River Site

The continued use of these facilities to chemically separate nuclear materials is an important factor for DOE consideration. Because the facilities do not meet current design and construction requirements, a facility-related vulnerability could produce environmental impacts (DOE, 1995a). As discussed above, the canyons would not maintain structural confinement of nuclear materials in a severe earthquake. The estimates of potential environmental consequences from accidents took this acknowledged vulnerability into consideration. If DOE were to design and construct a new facility, there would likely be no environmental consequences from a severe earthquake because a new facility would be designed to withstand such a force.

Similarly, in the Final Interim Management of Nuclear Materials EIS (DOE, 1995a), DOE considered other types of facility vulnerabilities in estimating the potential consequences from accidents. Some examples are (1) a fire that could spread in a facility until it breached containers of nuclear material due to a lack of detection or extinguisher systems, (2) systems that cool nuclear materials stored in tanks that could leak and transfer such material outside the facility before detection, or (3) piping configurations in the canyons that personnel could use inadvertently to transfer solutions of nuclear material to an outside facility tank where they could overflow or spill.

DOE has conducted many reviews to evaluate facility vulnerabilities and has assessed its facilities for compliance with current requirements. DOE has also analyzed the effect on workers and the public from normal and potential accident conditions which could result from operation of facilities with these vulnerabilities. The analysis work was accomplished as a part of ongoing safety review programs and is separate from the NEPA process. Such impact information is represented in the Final Interim Management of Nuclear Materials EIS and in this EIS. The analysis of impacts has, in some cases, prompted DOE to take corrective action based on potential impact alone. For example, DOE has disconnected some tanks of radioactive solutions in the canyons from the canyon cooling system and has isolated canyon tanks by removing interconnected piping to preclude leaks or an inadvertent transfer which could result in a release of radioactive material outside the canyon. In other cases, the potential impact was determined to be small and not sufficient to warrant actions beyond those which could be taken using existing facilities, equipment, and personnel. For example, one vulnerability common to many facilities is that the facility could sustain structural damage in the event of a severe earthquake. This type of earthquake has been estimated to occur once every several thousand years. It would be prohibitively expensive to modify facilities to ensure that no structural damage would occur from such an accident. Rather, DOE has provided mitigation for the consequences of such accidents using engineering safeguards, such as structurally reinforcing tanks, and administrative controls, such as limiting the amount of radioactive material that can be contained in a facility.

H-Canyon Process

The H-Canyon utilized a modified plutonium uranium extraction process (HM process). The HM process unit operations were dissolution, head end, first solvent extraction cycle, second uranium solvent extraction cycle, and second neptunium (or second actinide) solvent extraction cycle. Figure 2-13 shows the historic general H-Canyon process flow.

- Dissolution - Irradiated foreign research reactor spent nuclear fuel was brought into the hot canyon in water-filled casks and through an air lock by railcar. The spent nuclear fuel consists of HEU and LEU aluminum-based irradiated fuel. The spent nuclear fuel was removed from the casks and loaded into a dissolver tank. Heated nitric acid in the tank dissolved the foreign research reactor spent nuclear fuel, resulting in a solution containing enriched uranium, ^{237}Np, small quantities of plutonium, and fission products from the reactor irradiation process, and the cladding material. ^{237}Np should be insignificant in the chemical separation of foreign research reactor spent nuclear fuel.

- Head End - The head end process prepared the target solution for uranium, plutonium, and neptunium separation. First, gelatin was added to precipitate silica and other solid impurities. Then the solution was transferred to a centrifuge, where silica and other impurities were removed as waste, and the clarified product solution was adjusted with nitric acid and water. The wastestream generated from the head-end process was chemically neutralized and sent to high-level waste tanks.

- First Cycle - First cycle operation removed fission products and other chemical impurities, and separated the solution into two product streams for further processing. The chemical properties of acid/solvent/product solutions in contact with each other caused the fission products, the uranium, and the neptunium to separate from the solution containing plutonium.

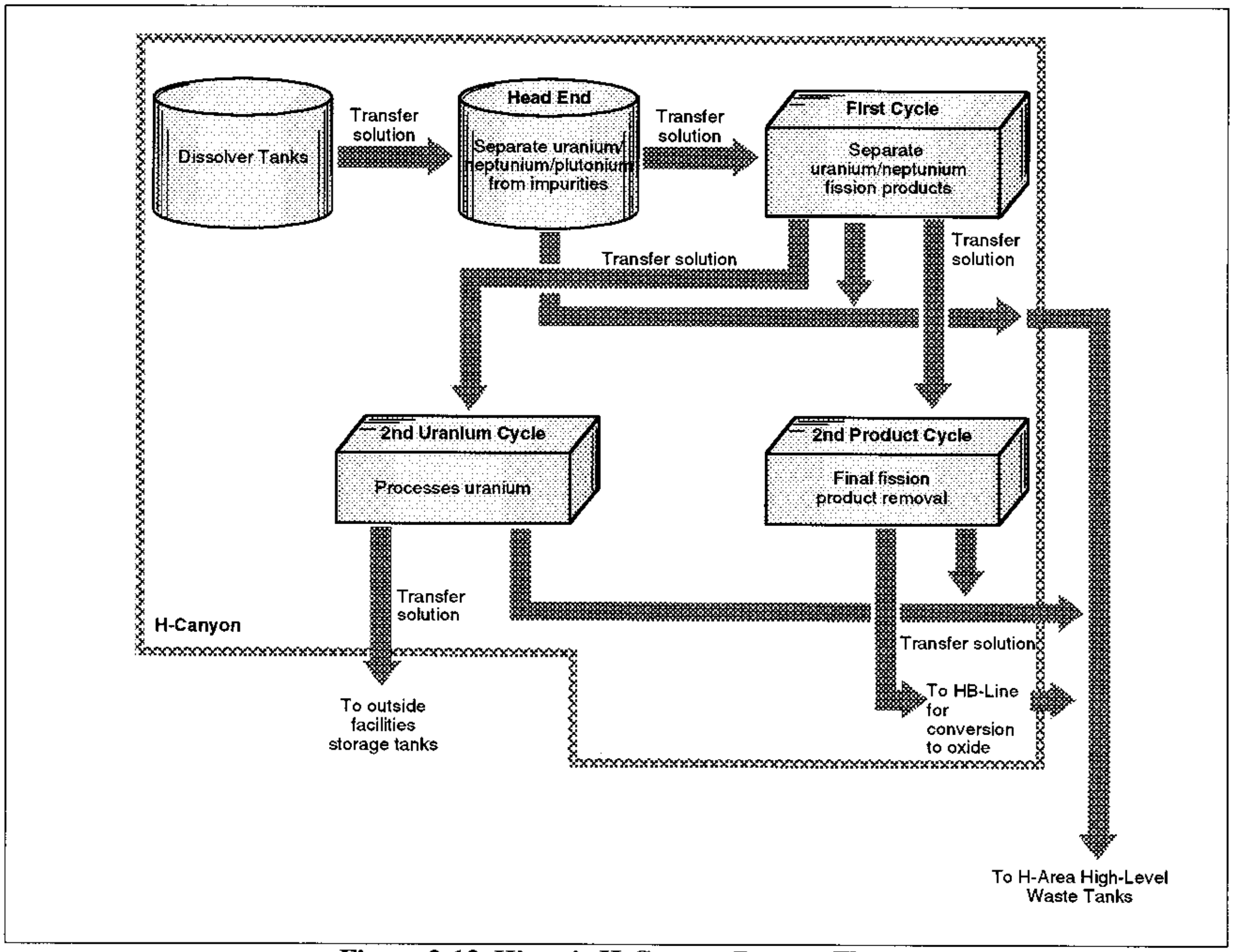


Figure 2-13 Historic H-Canyon Process Flow

- Second Uranium Cycle - The second uranium cycle purified the uranium solution from the first cycle and prepared the uranium for transfer. The purification occurred in a manner similar to that described for the first cycle. The ^{235}U product solution was transferred to storage tanks.

- Second Product Cycle - The second product cycle purified the neptunium solution from the first cycle by removing residual fission products, and prepare the neptunium for transfer. The process occurred in a manner similar to that for the first cycle. The impurities were removed and sent to the low-activity waste unit operation for processing. This cycle would probably be bypassed in the chemical separation of foreign research reactor spent nuclear fuel. Trace neptunium would be discarded as waste.

- High- and Low-Activity Waste - These unit operations reduced the volume of the aqueous streams containing fission products. The streams originate from the separation process unit operations, such as the first cycle. The fission product streams were then separated and sent to high-level waste tanks.

- Solvent Recovery - The primary purpose of this unit operation was to recover and recycle the solvent used in the first cycle. This operation reconditioned and removed impurities from the solvent. The purified solvent was returned to the first and second cycle, cycle reuse and the impurities were transferred to low-activity waste for processing.

F-Canyon Process

The Plutonium Uranium Extraction process at the F-Canyon includes unit operations such as dissolution, head end, first cycle, second uranium cycle, and second plutonium cycle. Unit operations that support the product recovery process were high-activity waste, low-activity waste, and solvent recovery. These were similar to those described for the HM process at H-Canyon with the exception of the Plutonium Uranium Extraction process. In the Plutonium Uranium Extraction process, the second plutonium cycle was equivalent to the second product cycle in the HM process.

Idaho National Engineering Laboratory Facilities

The Idaho Chemical Processing Plant (ICPP) facilities would use a Uranium Extraction process to chemically separate the foreign research reactor spent nuclear fuel for recovery of uranium, and isolation and solidification of the waste fission products resulting from the process. The principal facilities for foreign research reactor spent nuclear fuel chemical separation would be CPP-601, CPP-666, and CPP-602.

Foreign research reactor spent nuclear fuel would be received at the ICPP by truck or rail shipment. Both water-cooled and dry storage facilities would be used. Head-end equipment for initially dissolving or processing the spent nuclear fuel would be available. Aluminum-based clad fuel chemical separation could be conducted in CPP-601. TRIGA-type fuels would be processed in the Fluorinel Dissolution Process in CPP-666. The Fluorinel Dissolution Process cell could require some equipment modifications and additions to accommodate stainless steel-clad dissolution of the TRIGA fuel. However, the process knowledge and equipment is readily available. A new processing facility for uranium fuels is partially completed at the ICPP site. This facility, the Fuel Processing Restoration, is structurally complete but would require completion of services and installation of equipment for foreign research reactor spent nuclear fuel chemical separation.

The high-level liquid waste generated at ICPP during chemical separation of the spent nuclear fuel assemblies would be stored in several large stainless steel underground tanks until it could be processed. Liquid wastes would be converted to a solid calcine form, and then stored dry in bins housed in concrete vaults.

Aluminum and zircaloy fuel processing at ICPP consists of three principal stages. The first is the dissolution stage where fuels were dissolved forming a controlled solution. The second stage is the extraction process, which consists of first, second, and third extraction cycles. These cycles serve to separate and purify the uranium from fission products and material wastes prior to final operations. In the final operation, the solution is fed through a denitrator that conditions the feed material to a solid uranium product that can be packaged, transported, and recycled.

Foreign Reprocessing Facilities

Both France and the United Kingdom have modern fuel cycle facilities and offer reprocessing services to international customers. Either country could sign contracts with foreign research reactor owners/operators for receipt and reprocessing of their spent nuclear fuel, treatment of the waste, and fabrication of fresh fuel. Both France and the United Kingdom would require the country operating the reactor to take back the treated waste.

The French UP1 plant at Marcoule has reprocessed a variety of nuclear fuels, including gas/graphite power reactor fuel and magnesium-clad natural uranium metal fuel. The UP2 plant at La Hague is nearing completion of major renovations that will double its throughput and make it dedicated to oxide fuels. The UP3 plant, also at La Hague, is the newest French reprocessing plant. It started operations in 1990 and is also dedicated to oxide fuels. The French are vigorously engaged in reprocessing commercial power reactor fuel for foreign customers.

The British Prototype Fast Reactor Reprocessing Plant at Dounreay is a small plant associated with the Prototype Fast Reactor. However, it has established a precedent by receiving some research reactor spent nuclear fuel for reprocessing. The Magnox Fuel Reprocessing Plant at Sellafield reprocesses magnesium-clad uranium metal fuel from British gas-cooled reactors. The Thermal Oxide Reprocessing Plant (Thorp) is another large plant at Sellafield for Advanced Gas Reactor and light water reactor fuels. It started operating in January of 1994 and about two-thirds of its scheduled business through 2004 is for foreign customers.

2.6.5.3 Site Management Options

2.6.5.3.1 The Savannah River Site

Only two possible management sites, the Savannah River Site and the Idaho National Engineering Laboratory, would be capable of receiving and managing foreign research reactor spent nuclear fuel at the beginning of the proposed policy implementation period as described in Management Alternative 1.

If the Savannah River Site is the site for managing all DOE-owned spent nuclear fuel, foreign research reactor spent nuclear fuel would be received and managed there until ultimate disposition. If the Savannah River Site is not the site, foreign research reactor spent nuclear fuel could be received and managed at the Savannah River Site until another site(s) would be ready to receive the foreign research reactor spent nuclear fuel. The construction of new facilities for managing foreign research reactor spent nuclear fuel is estimated to take about 10 years; modifications to existing facilities could take less. For the purposes of the analyses, the period for Phase 1 is assumed to be 10 years. The period following Phase 1 until ultimate disposition is referred to as Phase 2 (approximately 30 years). The amount of spent nuclear fuel that could be received at the Savannah River Site under the basic implementation of Management Alternative 1 is dictated by the distribution considered in the Programmatic SNF&INEL Final EIS (DOE, 1995c) and discussed in Section 2.6.4.1. Accordingly, the Savannah River Site could receive one-half of the foreign research reactor spent nuclear fuel under the Decentralization and the 1992/1993 Planning Basis alternatives, all of the aluminum-based foreign research reactor spent nuclear fuel under the Regionalization by Fuel Type alternative, only the foreign research reactor spent nuclear fuel from Eastern ports under the Regionalization By Geography alternative, or all foreign research reactor spent nuclear fuel (both aluminum-based and TRIGA) under the Centralization alternative.

As a potential Phase 1 site under Management Alternative 1, the Savannah River Site would receive and manage foreign research reactor spent nuclear fuel at its existing wet storage facilities: RBOF and L-Reactor disassembly basin are considered for this purpose. RBOF is located at the H-Area. It is a facility with provisions for the receipt and storage of irradiated nuclear fuel elements. Since 1963, irradiated spent nuclear fuel elements have been received from offsite reactors and from the Savannah River Site reactors. RBOF provides the capability for underwater unloading of the transportation casks and the handling and storage of the foreign research reactor spent nuclear fuel. The foreign research reactor spent nuclear fuel would be stored in RBOF until the storage capacity is exhausted. Currently, RBOF has space for approximately 1,170 foreign research reactor spent nuclear fuel elements. This capacity could be increased to a total of 2,425 elements by rearranging and consolidating existing inventory. Descriptions of RBOF, the Savannah River Site reactor disassembly basins, and dry cask storage are provided in Appendix F, Section F.3.

The Savannah River Site reactor disassembly basins are not currently configured for storage of MTR type foreign research reactor spent nuclear fuel, however, minor modifications which would provide new storage racks, new handling equipment, safety documentation, etc., along with upgrades in progress to address vulnerabilities associated with water chemistry control, would permit receipt and management of foreign research reactor spent nuclear fuel. Installation of racks equivalent to those in RBOF would provide storage for approximately 20,000 foreign research reactor spent nuclear fuel elements per reactor basin. DOE is considering the L-Reactor disassembly basin for this purpose in this EIS. The modifications to RBOF and L-Reactor disassembly basin are part of the ongoing programs at the site to be performed independent of the proposed action in this EIS.

Between RBOF and the L-Reactor disassembly basin there would be sufficient storage capacity and handling capability to accommodate the receipt and management of foreign research reactor spent nuclear fuel during the estimated 10-year time period for Phase 1.

An additional option to enhance storage capacity during Phase 1 would be to use the existing facilities of RBOF and/or L-Reactor disassembly basin to unload the transportation casks, and provide storage capacity in dry storage casks which would be placed near the existing facility. The storage capacity available and estimated maximum receipt rate of foreign research reactor spent nuclear fuel at the Savannah River Site are shown in Figure F-16 of Appendix F.

As a Phase 2 site, the Savannah River Site would continue to receive foreign research reactor spent nuclear fuel beyond Phase 1 in a new dry storage facility that would be constructed at the H-Area. The location is preferred among a number of sites considered as discussed in Section F.4.1. Foreign research reactor spent nuclear fuel managed during Phase 1 would be transferred to the new facility for management during Phase 2 (approximately 30 years), until ultimate disposition. The dry storage would encompass a number of design examples which were provided in Section 2.6.5.1.1 and Appendix F. Figure 2-14 depicts the facilities and locations considered at the Savannah River Site.

The analysis of environmental impacts from management of foreign research reactor spent nuclear fuel at the Savannah River Site is based on the above considerations. The analysis options selected do not represent all possible combinations, but a reasonable set which provides a typical, and in many cases, bounding estimate of the resulting impacts.

The specific analysis options under the basic implementation of Management Alternative 1, discussed in Section 2.2.1, are as follows:

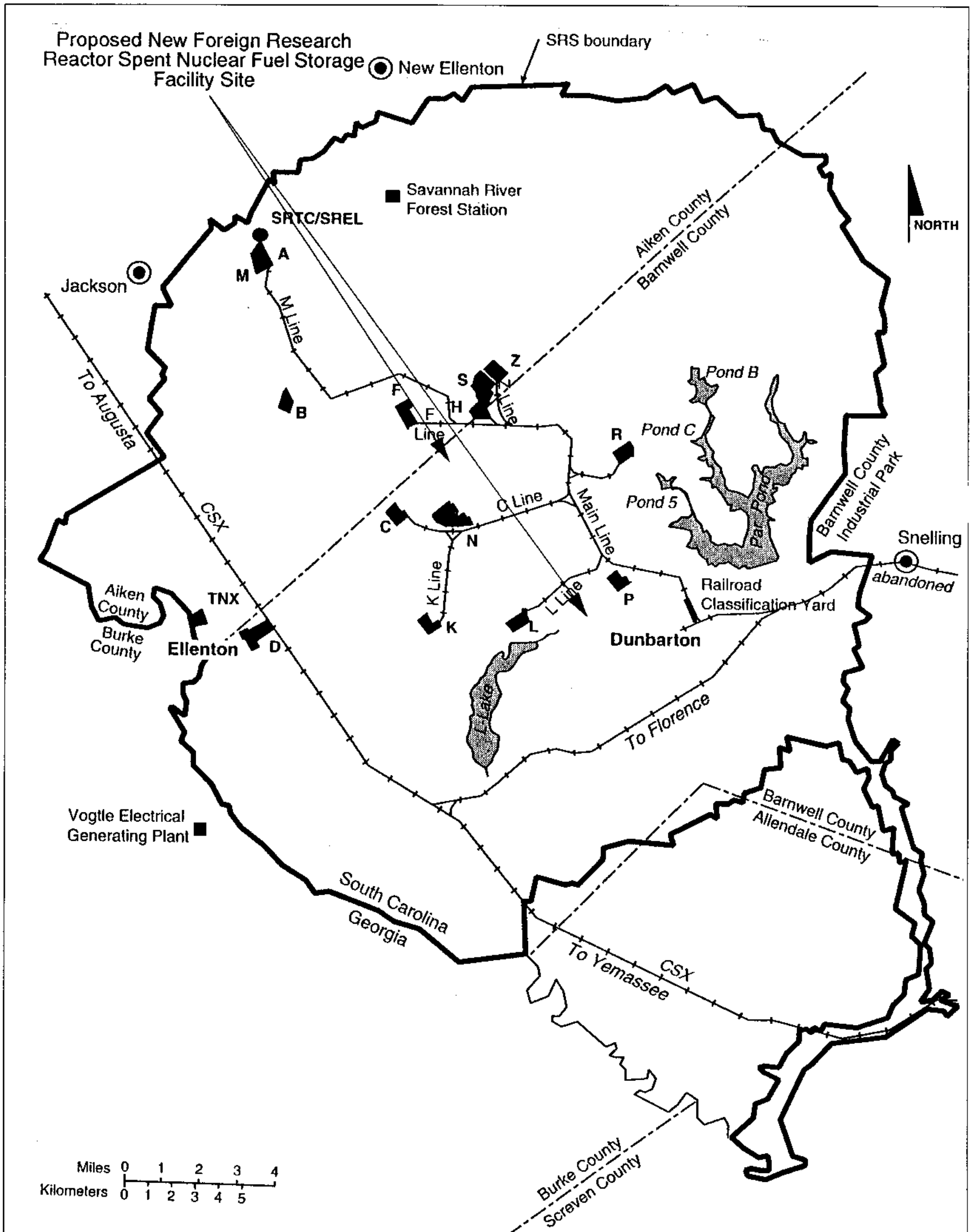


Figure 2-14 Location of Principal Facilities at the Savannah River Site

1A. The Savannah River Site would receive and manage foreign research reactor spent nuclear fuel during Phase 1 and store it at the RBOF and/or the L-Reactor disassembly basin. For the purpose of the analysis, the amount of fuel to be managed is all foreign research reactor spent nuclear fuel that would be received in a 10-year period (17,500 elements). The fuel would be shipped offsite at the end of Phase 1.

1B. Foreign research reactor spent nuclear fuel managed under analysis option 1A would be transferred to a newly constructed dry storage facility, where it would be managed until ultimate disposition. Spent nuclear fuel arriving in the United States after Phase 1 concludes would be received and managed at the new dry storage facility. For the purpose of the analysis, the amount of spent nuclear fuel that would be managed would be all the foreign research reactor spent nuclear fuel (22,700 elements).

The implementation alternatives of Management Alternative 1, discussed in Section 2.2.2, introduce additional analysis options that could be considered for the Savannah River Site as follows:

- Under Implementation Subalternative 1a (Section 2.2.2.1), the amount of fuel to be received in the United States would be reduced to 5,000 elements. In this case, the Savannah River Site would be likely to receive and manage foreign research reactor spent nuclear fuel in existing facilities during the Phase 1 period. The impacts would be bounded by analysis option 1A (above). Impacts of construction and operation of the dry storage facility considered in analysis option 1B would bound those of the facility required to accommodate this amount of fuel. The spent nuclear fuel would either be shipped offsite after Phase 1, or it would be managed along with the rest of the spent nuclear fuel that would be managed at the Savannah River Site.

- Under Implementation Subalternative 1b (Section 2.2.2.1), the Savannah River Site would receive only HEU from the foreign research reactors eligible under the policy. The amount of HEU would be approximately 4.6 MTHM, representing 11,200 elements. The impacts from the management of this amount of fuel at the Savannah River Site would be bounded by analysis options 1A and 1B above.

- Under Implementation Subalternative 1c (Section 2.2.2.1), the Savannah River Site would receive target material in addition to the foreign research reactor spent nuclear fuel considered under the basic implementation of Management Alternative 1. The receipt and management of this material, which, in uranium content, represents approximately 620 typical foreign research reactor spent nuclear fuel elements, would increase the impacts of analysis options 1A or 1B (above) by a small percentage.

- Under Implementation Subalternative 2a (Section 2.2.2.2), the duration of the policy would be decreased to 5 years; and, therefore, the amount of spent nuclear fuel available for management would also be decreased. The impacts from the management of the decreased amount of spent nuclear fuel at the Savannah River Site would be bounded by analysis options 1A or 1B above.

- Under Implementation Subalternative 2b, (Section 2.2.2.2) the acceptance of a small portion of the spent nuclear fuel would be extended over an indefinite period of time, but the amount of spent nuclear fuel to be received and managed would remain constant. The impacts would be the same as in analysis options 1A or 1B.

- Under Implementation Alternative 3 (Section 2.2.2.3), DOE and the Department of State would consider alternative financial arrangements. These arrangements would affect the amount of spent nuclear fuel that would be managed in the United States because the foreign research reactors would consider their own alternatives as to whether or not to send the spent nuclear fuel to the United States. The amount of foreign research reactor spent nuclear fuel in this case cannot be quantified. The upper limit, however, is considered under analysis options 1A and 1B (above), which would be bounding.

- Under Implementation Alternative 4 (Section 2.2.2.4), DOE and the Department of State would consider alternatives for the location where title of foreign research reactor spent nuclear fuel would be taken. The choices do not affect the management options at the Savannah River Site.

- Under Implementation Alternative 5 (Section 2.2.2.5), DOE would consider wet storage technology for Phase 2 management. DOE would implement this alternative by constructing a new wet storage facility at the H-Area or by using the Barnwell Nuclear Fuels Plant (BNFP), owned by Allied General Nuclear Services. DOE would have to acquire the facility which could be ready for use in approximately 5 years. Therefore, if the Savannah River Site was a selected site under either the Regionalization by Fuel Type or Centralization alternatives, Phase 2 at the Savannah River Site could start as early as 5 years from the start of the implementation period if BNFP were used under this implementation alternative. The new wet storage facility is described in Section 2.6.5.1.2. BNFP is described in Appendix F, Section F.1. For this implementation alternative, an analysis option 1C is considered, which is similar to 1B, as follows:

1C. The spent nuclear fuel managed under analysis option 1A would be transferred to a newly constructed wet storage facility or the BNFP where it would be managed until ultimate disposition. Spent nuclear fuel arriving in the United States after Phase 1 concludes (i.e., during Phase 2) would be received and managed at these facilities. For the purpose of the analysis, the amount of spent nuclear fuel that would be managed in these facilities would be all the foreign research reactor spent nuclear fuel (22,700 elements).

- Under Implementation Alternative 6 (Section 2.2.2.6), DOE and the Department of State would consider chemical separation of foreign research reactor spent nuclear fuel in the United States. As noted in Section 2.3.6, the Savannah River Site is limited to chemical separation of aluminum-based foreign research reactor spent nuclear fuel.

Under Management Alternative 2, discussed in Section 2.3, DOE and the Department of State would assess the management of foreign research reactor spent nuclear fuel in a foreign location which would include an evaluation of foreign reprocessing with acceptance by the United States of the vitrified high-level waste resulting from reprocessing. The waste would be received and managed at the Defense Waste Processing Facility at the Savannah River Site. DOE and the Department of State estimate that the total volume of the vitrified high-level waste would be about 2.4 m^3 (85 ft^3) and it would fill about 16 European-size canisters. A European-sized canister is about four times smaller than the canister used in the Defense Waste Process Facility at the Savannah River Site. Some modification to the waste handling facility at the Savannah River Site would be necessary to accommodate the smaller canisters.

Under Management Alternative 3 (Hybrid Alternative) discussed in Section 2.4, the Savannah River Site would receive the aluminum-based fuel which would not be reprocessed overseas. This spent nuclear fuel would be processed at the Savannah River Site chemical separation facilities in the same manner as

Implementation Alternative 6 above. The amount of aluminum-based spent nuclear fuel to be chemically separated would be approximately 12,200 elements, 12.9 MTHM, 72 m^3 (2,700 ft^3) as indicated in Table 2-4.

Table 2-11 presents an overview of the foreign research reactor spent nuclear fuel management options, quantities of foreign research reactor spent nuclear fuel assumed for the analysis, and facilities considered.

Table 2-11 Proposed Quantities of Foreign Research Reactor Spent Nuclear Fuel and Management Options at the Savannah River Site

FRR EIS Management Alternative		*FRR SNF Elements*	*Percentage of FRR SNF Total Elements*	*Storage Option/Technology*					
				Dry Storage	*Wet Storage*			*Existing Facilities Plus Dry Cask*[c]	*Chemical Separation*
Management Alternative 1				*New*	*Existing*[a]	*BNFP*[b]	*New*		
All FRR SNF	Phase 1	17,500	77%	NA	A	NA	NA	A	NA
	Phase 2[d]	22,700	100%	A	NA	A	A	NA	NA
Eastern FRR SNF	Phase 1	12,600	56%	NA	A	NA	NA	A	NA
	Phase 2	16,400	72%	A	NA	A	A	NA	NA
Aluminum-based FRR SNF	Phase 1	13,600	60%	NA	A	NA	NA	A	NA
	Phase 2	17,800	78%	A	NA	A	A	NA	NA
Chemical Separation/Storage	Phase 2	17,800	78%	NA	A	NA	NA	A	A
Management Alternative 3									
Aluminum-Based FRR SNF Chemical Separation/Storage		12,300	54%	NA	A	NA	NA	A	A

A = Applicable
NA = Not Applicable
FRR = foreign research reactor
SNF = spent nuclear fuel
[a] *RBOF and L-Reactor basin*
[b] *BNFP could be available for use 5 years after the start of implementation.*
[c] *Dry cask storage would use an existing facility for loading operations.*
[d] *Phase 2 values represent total number of foreign research reactor spent nuclear fuel elements requiring management at the site.*

2.6.5.3.2 Idaho National Engineering Laboratory

Only two possible management sites, the Savannah River Site and the Idaho National Engineering Laboratory, would be capable of receiving and managing foreign research reactor spent nuclear fuel at the beginning of the proposed policy implementation period.

If the Idaho National Engineering Laboratory is the site for managing all DOE-owned spent nuclear fuel, foreign research reactor spent nuclear fuel would be received and managed there until ultimate disposition. If the Idaho National Engineering Laboratory is not the site, foreign research reactor spent nuclear fuel could be received and managed at the Idaho National Engineering Laboratory until another site(s) would be ready to receive the foreign research reactor spent nuclear fuel. The construction of new facilities for managing foreign research reactor spent nuclear fuel is estimated to take about 10 years; this period is referred to as Phase 1. The period following Phase 1 until ultimate disposition is referred to as Phase 2 (approximately 30 years). The amount of spent nuclear fuel that could be received at the Idaho National Engineering Laboratory under the basic implementation of Management Alternative 1 is dictated by the distribution considered in the Programmatic SNF&INEL Final EIS (DOE, 1995c). Accordingly, the Idaho National Engineering Laboratory could receive one-half of the foreign research reactor spent nuclear fuel under the Decentralization and the 1992/1993 Planning Basis alternatives, all of the TRIGA-type foreign research reactor spent nuclear fuel under the Regionalization by Fuel Type alternative, only the foreign research reactor spent nuclear fuel from Western ports under the Regionalization By Geography alternative, or all foreign research reactor spent nuclear fuel under the Centralization alternative.

As a potential Phase 1 site, the Idaho National Engineering Laboratory would receive and manage foreign research reactor spent nuclear fuel at existing dry and wet storage facilities. The existing facilities identified for this purpose would be the Fluorinel Dissolution and Fuel Storage (FAST) facility in CPP-666, the Irradiated Fuel Storage Facility (IFSF) in CPP-603, and the CPP-749 storage area. Descriptions of these facilities are provided in Appendix F, Section F.3.

The FAST facility is a modern underwater storage facility which has been used in the past for receipt and storage of foreign research reactor spent nuclear fuel. It has the capability to receive and unload spent nuclear fuel casks at a rate of approximately five per week. Storage capacity for up to 8,400 foreign research reactor spent nuclear fuel elements could be provided in a 10-year period by using the spent nuclear fuel storage racks that would be installed. The capability of the FAST facility to receive foreign research reactor spent nuclear fuel in the near term is limited due to the number of activities scheduled through FY 1998. Considering these activities, DOE estimates that 3,600 elements could be received by the end of 1999 at the FAST facility.

The IFSF is a shielded dry storage vault originally constructed for Fort St. Vrain reactor fuel. The storage capacity available is for approximately 9,000 foreign research reactor spent nuclear fuel elements. However, as with the FAST facility, many activities are already scheduled for the facility. Considering these activities, foreign research reactor spent nuclear fuel could not be received until sometime in FY 1997 and could continue at the rate of 50 shipments per year (approximately 1,500 elements) thereafter.

The CPP-749 underground spent nuclear fuel storage area is a dry storage facility with a remote unloading area and vault storage. With some refurbishment it could provide space for 3,600 elements starting in FY 1998. The spent nuclear fuel would go through the IFSF to be placed in baskets and transferred to a compatible storage cask. The refurbishments of existing facilities are part of the ongoing programs at the site, to be performed independent of the proposed action in this EIS.

Between these facilities there is sufficient storage space and handling capacity to accommodate the receipt and management of foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory during the Phase 1 period. The storage capacity available and estimated maximum receipt rate of foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory are shown in Figure F-18 of Appendix F.

An additional option to enhance storage capacity during Phase 1 would be to use the existing facilities to unload the transportation casks, and provide storage capacity in dry storage casks which would be placed near the existing facility. Descriptions of the Idaho National Engineering Laboratory existing facilities are provided in Appendix F. The location of these facilities at the Idaho National Engineering Laboratory are shown in Figure 2-15.

As a Phase 2 site, the Idaho National Engineering Laboratory would continue to receive and manage foreign research reactor spent nuclear fuel at existing facilities until a new dry storage facility were to become operational at the site. Foreign research reactor spent nuclear fuel managed at existing facilities

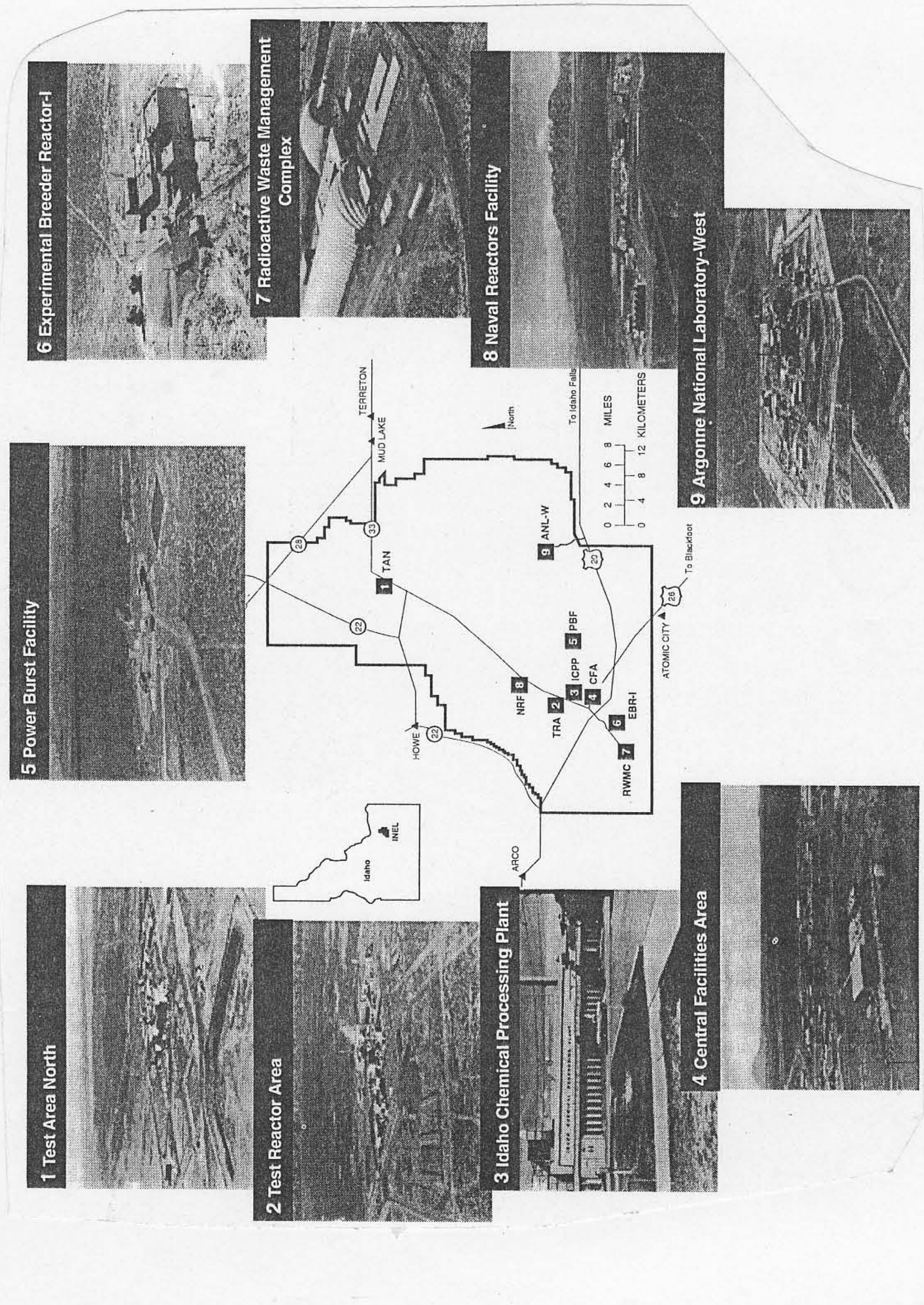


Figure 2-15 Location of Principal Facilities at the Idaho National Engineering Laboratory

would then be transferred to the new facility where it would remain until ultimate disposition. The new facility would also receive foreign research reactor spent nuclear fuel shipments directly from ports after the 10-year policy period. Dry storage encompasses both the dry vault design and the dry cask design as described in Section 2.6.5.1.1.

The analysis of environmental impacts from management of foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory is based on the above considerations. The analysis options selected do not represent all possible combinations, but a reasonable set which provides a typical, and in many cases, bounding estimate of the resulting impacts.

The specific analysis options under the basic implementation of Management Alternative 1, discussed in Section 2.2.1, are as follows:

2A. The Idaho National Engineering Laboratory would receive and manage foreign research reactor spent nuclear fuel during Phase 1 and store it at the FAST, the IFSF, and/or the CPP-749 facilities. For the purpose of the analysis, the amount of fuel to be managed is all foreign research reactor spent nuclear fuel that would be received in a 10-year period (17,500 elements). The fuel would be shipped offsite at the end of Phase 1.

2B. Foreign research reactor spent nuclear fuel managed under analysis option 2A would be transferred to a newly constructed dry storage facility where it would be managed until ultimate disposition. Spent nuclear fuel arriving at the United States after Phase 1 concludes would be received and managed at the new dry storage facility until ultimate disposition. For the purpose of the analysis, the amount of spent nuclear fuel that would be stored in the dry storage facility would be all the foreign research reactor spent nuclear fuel (22,700 elements).

The implementation alternatives of Management Alternative 1 discussed in Section 2.2.2 introduce additional analysis options that could be considered for the Idaho National Engineering Laboratory as follows:

- Under Implementation Subalternative 1a (Section 2.2.2.1), the amount of spent nuclear fuel to be received in the United States would be reduced to 5,000 elements. In this case, the Idaho National Engineering Laboratory would be likely to receive and manage foreign research reactor spent nuclear fuel in existing facilities during the Phase 1 period. The impacts would be bounded by analysis option 2A above. The dry storage facility considered in analysis option 2B would be sized to accommodate this amount of fuel. The fuel would either be shipped offsite after Phase 1 or it would be managed along with the rest of the spent nuclear fuel that would be managed at the Idaho National Engineering Laboratory.

- Under Implementation Subalternative 1b (Section 2.2.2.1), the Idaho National Engineering Laboratory would receive only HEU from the reactors eligible under the proposed action. The amount of HEU would be approximately 4.6 MTHM, representing 11,200 elements. The impacts from the management of this amount of fuel at the Idaho National Engineering Laboratory would be bounded by analysis options 2A and 2B above.

- Under Implementation Subalternative 1c (Section 2.2.2.1), the Idaho National Engineering Laboratory would receive target material in addition to the foreign research reactor spent nuclear fuel considered under the basic implementation of Management Alternative 1. The receipt and management of this material, which represents, in uranium content, approximately 620 typical foreign research reactor spent nuclear fuel elements, would increase the impacts of analysis options 2A or 2B (above) by a small percentage.

- Under Implementation Subalternative 2a (Section 2.2.2.2), the duration of the policy would be decreased to 5 years and therefore the amount of spent nuclear fuel available for management would also be decreased. The impacts from the management of the decreased amount of spent nuclear fuel at the Idaho National Engineering Laboratory would be bounded by analysis options 2A or 2B above.

- Under Implementation Subalternative 2b, (Section 2.2.2.2) the acceptance of a small portion of the spent nuclear fuel would be extended over an indefinite period of time, but the amount of spent nuclear fuel to be received and managed would remain constant. The impacts would be the same as in analysis options 2A or 2B.

- Under Implementation Alternative 3 (Section 2.2.2.3), DOE and the Department of State would consider alternative financial arrangements. These arrangements would affect the amount of spent nuclear fuel that would be managed in the United States because the foreign research reactors would consider their own alternatives about whether to send the spent nuclear fuel to the United States. The amount of foreign research reactor spent nuclear fuel in this case cannot be quantified. The upper limit, however, is considered under analysis options 2A or 2B which would be bounding.

- Under Implementation Alternative 4 (Section 2.2.2.4), DOE and the Department of State would consider alternatives for the location where title of the foreign research reactor spent nuclear fuel would be taken. The choices do not affect the management options at the Idaho National Engineering Laboratory.

- Under Implementation Alternative 5 (Section 2.2.2.5), DOE would consider construction of a new wet storage facility at the Idaho National Engineering Laboratory for Phase 2 until ultimate disposition. The new wet storage facility is described in Section 2.6.5.1.2. For this implementation alternative, an analysis option 2C, which is similar to analysis option 2B, is considered as follows:

2C. The spent nuclear fuel managed under analysis option 2A would be transferred to a newly constructed wet storage facility where it would be managed until ultimate disposition. Spent nuclear fuel arriving in the United States after Phase 1 concludes (i.e., during Phase 2) would be received and managed at the new wet storage facility until ultimate disposition. For the purpose of the analysis, the amount of spent nuclear fuel that would be managed in the wet storage facility would be all the foreign research reactor spent nuclear fuel (22,700 elements).

- Under Implementation Alternative 6 (Section 2.2.2.6), DOE and the Department of State would consider chemical separation of foreign research reactor spent nuclear fuel in the United States. As noted in the discussion in Section 2.3.6, chemical separation of both aluminum-based and TRIGA foreign research reactor spent nuclear fuel is evaluated for the Idaho National Engineering Laboratory.

Under Management Alternative 3 (Hybrid Alternative), discussed in Section 2.4, the Idaho National Engineering Laboratory would receive the foreign research reactor TRIGA spent nuclear fuel. This spent nuclear fuel would be managed at the Idaho National Engineering Laboratory in existing facilities until final disposition. The amount of TRIGA spent nuclear fuel to be stored would be 4,900 elements, 1.0 MTHM, and about 4 m^3 (200 ft^3) as indicated in Table 2-4.

Table 2-12 presents an overview of the foreign research reactor spent nuclear fuel management options, quantities of foreign research reactor spent nuclear fuel assumed for the analysis, and facilities considered.

Table 2-12 Proposed Quantities of Foreign Research Reactor Spent Nuclear Fuel and Management Options at the Idaho National Engineering Laboratory

FRR EIS Management Alternative		*FRR SNF Elements*	*Percentage of Total FRR SNF Elements*	*Storage Option/Technology*					
				Dry Storage		*Wet Storage*		*Existing Facilities plus Casks*[c]	*Chemical Separation*
Management Alternative 1				*New*	*Existing*[a]	*New*	*Existing*[b]		
All FRR SNF	Phase 1	17,500	77%	NA	A	NA	A	A	NA
	Phase 2[d]	22,700	100%	A	NA	A	NA	NA	NA
Western FRR SNF	Phase 1	4,800	21%	NA	A	NA	A	A	NA
	Phase 2	6,300	28%	A	NA	A	NA	NA	NA
TRIGA FRR SNF	Phase 1	3,800	17%	NA	NA	NA	A	A	NA
	Phase 2	4,900	22%	NA	A	A	NA	NA	NA
Chemical Separation/Storage		22,700	100%	NA	A	NA	A	A	A
Management Alternative 3									
TRIGA FRR SNF/ Storage		4,900	22%	NA	A	NA	A	A	NA

A = Applicable
NA = Not Applicable
FRR = foreign research reactor
SNF = spent nuclear fuel
[a] *IFSF, CPP-749*
[b] *FAST*
[c] *Existing facilities augmented by dry cask storage.*
[d] *Phase 2 values represent total number of foreign research reactor spent nuclear fuel elements requiring management at the site.*

2.6.5.3.3 The Hanford Site

Options for receiving and managing foreign research reactor spent nuclear fuel at the Hanford Site are primarily dictated by the Programmatic SNF&INEL Final EIS (DOE, 1995c) alternatives, and the lack of suitable facilities at the Hanford Site to receive foreign research reactor spent nuclear fuel at the beginning of the proposed policy period.

If the Hanford Site is the site to manage DOE-owned spent nuclear fuel under the Programmatic SNF&INEL Final EIS, foreign research reactor spent nuclear fuel would be received and managed first at the Savannah River Site and/or the Idaho National Engineering Laboratory for the period (Phase 1) required for the Hanford Site to have new facilities constructed and operational to accommodate the spent nuclear fuel. As discussed in previous sections, Phase 1 is estimated to be about 10 years. At the end of Phase 1 (e.g., start of Phase 2) the Hanford Site would be able to receive and manage foreign research reactor spent nuclear fuel that would be shipped from the Savannah River Site and/or the Idaho National

Engineering Laboratory and directly from the ports for those shipments made after Phase 1 concludes. Management of the foreign research reactor spent nuclear fuel would continue at the Hanford Site until ultimate disposition.

The amount of spent nuclear fuel that would be received and managed at the Hanford Site under the basic implementation of Management Alternative 1 is dictated by the distribution considered in the Programmatic SNF&INEL Final EIS (DOE, 1995c). Accordingly, in Phase 2, the Hanford Site could receive the TRIGA foreign research reactor spent nuclear fuel managed at the Idaho National Engineering Laboratory during Phase 1, Western foreign research reactor spent nuclear fuel under the Regionalization By Geography alternative, or all foreign research reactor spent nuclear fuel under the Centralization alternative.

Under the basic implementation of Management Alternative 1, and as a Phase 2 site, the Hanford Site would receive and manage foreign research reactor spent nuclear fuel at a new dry storage facility constructed at the 200 Area Plateau or the Fuel Material Examination Facility (FMEF), which is a partially completed, large, hot cell facility. The new dry storage facility is described in Section 2.6.5.1.1. Description of the FMEF is provided in Appendix F, Section F.3. Figure 2-16 displays the potential construction locations for foreign research reactor spent nuclear fuel storage at the Hanford Site. FMEF is located near the Fast Flux Test Facility.

The analysis of environmental impacts from management of foreign research reactor spent nuclear fuel at the Hanford Site is based on the above considerations. The analysis options selected do not represent all possible combinations, but a reasonable set that provides a typical, and in some cases, bounding estimate of the resulting impacts.

The specific analysis option under the basic implementation of Management Alternative 1, discussed in Section 2.2.1, is as follows:

3A. The spent nuclear fuel managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 would be shipped to the Hanford Site where it would be managed at a new dry storage facility constructed either at the 200 Area Plateau or at FMEF. Spent nuclear fuel arriving in the United States after Phase 1 concludes (i.e., during Phase 2) would also be received and managed at the new facility until ultimate disposition. For the purposes of the analysis, the total amount of spent nuclear fuel that would be managed in the dry storage facility would be all the foreign research reactor spent nuclear fuel (22,700 elements). If the Hanford Site were to receive TRIGA from the Idaho National Engineering Laboratory or only western spent nuclear fuel, the dry storage facility would be sized accordingly. The impacts from a smaller size facility would be bounded by the option analyzed.

The implementation alternatives of Management Alternative 1, which are discussed in Section 2.2.2, introduce additional analysis options that could be considered for the Hanford Site as follows:

- Under Implementation Subalternative 1a (Section 2.2.2.1), the amount of spent nuclear fuel to be received in the United States would be reduced to 5,000 elements. In this case, the Hanford Site would receive the foreign research reactor spent nuclear fuel from the Idaho National Engineering Laboratory and/or the Savannah River Site and manage it in facilities sized for this amount. The impacts from the management of this amount of spent nuclear fuel would be bounded by analysis option 3A.

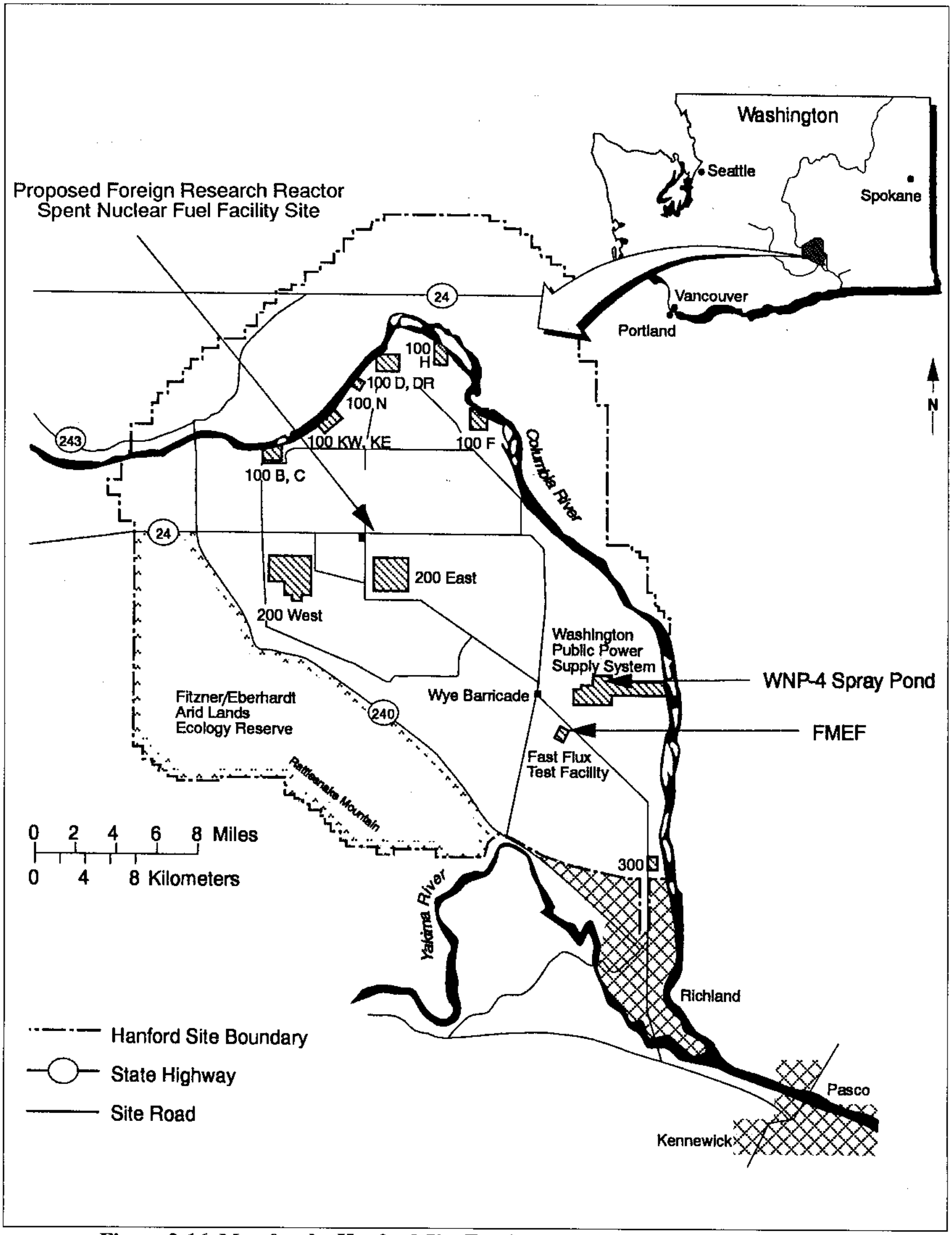


Figure 2-16 Map for the Hanford Site Foreign Research Reactor Spent Nuclear Fuel Storage (in the 200 Areas)

- Under Implementation Subalternative 1b (Section 2.2.2.1), the Hanford Site would receive only HEU from the Idaho National Engineering Laboratory and/or the Savannah River Site. The amount would be approximately 4.6 MTHM, representing 11,200 elements. The impacts from the management of this amount of fuel at the Hanford Site would be bounded by analysis option 3A above.

- Under Implementation Subalternative 1c (Section 2.2.2.1), the Hanford Site would receive target material in addition to the foreign research reactor spent nuclear fuel considered under the basic implementation of Management Alternative 1. The receipt and management of this material, which represents in uranium content approximately 620 typical foreign research reactor spent nuclear fuel elements, would increase the impacts of analysis option 3A by a small percentage.

- Under Implementation Subalternative 2a (Section 2.2.2.2), the duration of the policy would be decreased to 5 years; and, therefore, the amount of spent nuclear fuel available for management would also be decreased. In this case, the Hanford Site would receive all foreign research reactor spent nuclear fuel from the Savannah River Site and/or the Idaho National Engineering Laboratory. The impacts from the management of the decreased amount of spent nuclear fuel at the Hanford Site would be bounded by analysis option 3A above.

- Under Implementation Subalternative 2b (Section 2.2.2.2), the acceptance of a small portion of the fuel would be extended over an indefinite period of time, but the amount of spent nuclear fuel to be received and managed would remain constant. The impacts would be the same as in option 3A.

- Under Implementation Alternative 3 (Section 2.2.2.3), DOE and the Department of State would consider alternative financial arrangements. These arrangements would affect the amount of spent nuclear fuel that would be managed in the United States as the foreign research reactors would consider their own alternatives on whether to send the spent nuclear fuel to the United States. The amount of spent nuclear fuel in this case cannot be quantified; however, the upper limit, which is considered under analysis option 3A, would be bounding.

- Under Implementation Alternative 4 (Section 2.2.2.4), DOE and the Department of State would consider alternatives for the location where title of the foreign research reactor spent nuclear fuel would be taken. The choices do not affect the management options at the Hanford Site.

- Under Implementation Alternative 5 (Section 2.2.2.5), DOE would consider construction of a new wet storage facility at the Hanford Site for Phase 2 until ultimate disposition. For this implementation alternative, an analysis option 3B, which is similar to 3A, is considered as follows:

3B. The spent nuclear fuel managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 is shipped to the Hanford Site where it would be managed at a new wet storage facility constructed at either the 200 Area Plateau or the WNP-4 Spray Pond facility. Spent nuclear fuel arriving in the United States after Phase 1 concludes (i.e., during Phase 2) would also be received and managed at the new facility until ultimate disposition. For the purposes of analysis, the total amount of spent nuclear fuel to be managed in the wet storage facility would be all the foreign research reactor spent nuclear fuel (22,700 elements). If the Hanford Site were to receive only TRIGA fuel from the Idaho National Engineering Laboratory, or only western fuel, the wet storage facility would be sized accordingly. The impacts from a smaller size facility would be bounded by the option analyzed.

- Under Implementation Alternative 6 (Section 2.2.2.6), DOE and the Department of State would consider chemical separation of foreign research reactor spent nuclear fuel in the United States. Based on the discussion in Section 2.3.6, the Hanford Site would not be considered as a site for chemical separation. The Hanford Site is also not considered under the Hybrid Alternative discussed in Section 2.4.

Table 2-13 presents an overview of the foreign research reactor spent nuclear fuel management options, quantities of foreign research reactor spent nuclear fuel assumed for the analysis, and facilities considered.

Table 2-13 Proposed Quantities of Foreign Research Reactor Spent Nuclear Fuel and Management Options at Hanford Site

Management Alternative 1		*FRR SNF Element*	*Percentage of Total FRR SNF Elements*	*Storage Option/Technology*			
				Dry Storage		*Wet Storage*	
				New at FMEF	*New*	*New at WNP-4*	*New*
All FRR SNF	Phase 2	22,700	100%	A	A	A	A
Western FRR SNF	Phase 2	6,300	28%	A	A	A	A
TRIGA FRR SNF	Phase 2	4,900	22%	A	A	A	A

A = Applicable
FRR = foreign research reactor
SNF = spent nuclear fuel

2.6.5.3.4 The Oak Ridge Reservation

The options for receiving and managing foreign research reactor spent nuclear fuel at the Oak Ridge Reservation are primarily dictated by the Programmatic SNF&INEL Final EIS (DOE, 1995c) alternatives and the lack of suitable facilities at the Oak Ridge Reservation to receive foreign research reactor spent nuclear fuel at the beginning of the proposed policy period.

If the Oak Ridge Reservation is the site to manage DOE-owned spent nuclear fuel under the Programmatic SNF&INEL Final EIS, foreign research reactor spent nuclear fuel would be received and managed first at the Savannah River Site and/or the Idaho National Engineering Laboratory for the period (Phase 1) required for the Oak Ridge Reservation to construct and to place in operation new facilities to accommodate the spent nuclear fuel. As discussed in previous sections, Phase 1 is estimated to be about 10 years. At the end of Phase 1 (e.g., start of Phase 2) the Oak Ridge Reservation would be able to receive and manage foreign research reactor spent nuclear fuel that would be shipped from the Savannah River Site and/or the Idaho National Engineering Laboratory and directly from the ports for those shipments made after Phase 1 concludes. Management of the foreign research reactor spent nuclear fuel would continue at the Oak Ridge Reservation until ultimate disposition.

The amount of spent nuclear fuel that would be received and managed at the Oak Ridge Reservation under the basic implementation of Management Alternative 1 is dictated by the distribution considered in the Programmatic SNF&INEL Final EIS (DOE, 1995c). Accordingly, in Phase 2, the Oak Ridge Reservation could receive aluminum-based foreign research reactor spent nuclear fuel managed at the Savannah River

Site during Phase 1, Eastern foreign research reactor spent nuclear fuel under the Regionalization by Geography alternative, or all foreign research reactor spent nuclear fuel under the Centralization alternative.

Under the basic implementation of Management Alternative 1, and as a Phase 2 site, the Oak Ridge Reservation would receive and manage foreign research reactor spent nuclear fuel at a new dry storage facility to be constructed at the West Bear Creek Valley Site. The location is preferred among the four locations considered in a siting study performed for spent nuclear fuel management (MMES, 1994). The four locations considered are shown in Figure 2-17. Description of the new dry storage facility is provided in Section 2.6.5.1.1.

The analysis of environmental impacts from management of foreign research reactor spent nuclear fuel at the Oak Ridge Reservation is based on the above considerations. The analysis options selected do not represent all possible combinations but a reasonable set that provides a typical, and in some cases, bounding estimate of the resulting impacts.

The specific analysis option under the basic implementation of Management Alternative 1, discussed in Section 2.2.1, is as follows:

4A. The spent nuclear fuel managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 would be shipped to the Oak Ridge Reservation where it would be managed at a new dry storage facility until ultimate disposition. Spent nuclear fuel arriving in the United States after Phase 1 concludes (i.e., during Phase 2) would also be received and managed at the new facility until ultimate disposition. For the purposes of the analysis, the total amount of spent nuclear fuel that would be managed in the dry storage facility would be all the foreign research reactor spent nuclear fuel (22,700 elements).

The implementation alternatives of Management Alternative 1, which are discussed in Section 2.2.2, introduce additional analysis options that could be considered for the Oak Ridge Reservation as follows:

- Under Implementation Subalternative 1a (Section 2.2.2.1), the amount of spent nuclear fuel to be received in the United States would be reduced to 5,000 elements. In this case, the Oak Ridge Reservation would receive the foreign research reactor spent nuclear fuel from the Idaho National Engineering Laboratory or the Savannah River Site and manage it in facilities sized for this amount. The impacts from the management of this amount of spent nuclear fuel would be bounded by analysis option 4A.

- Under Implementation Subalternative 1b (Section 2.2.2.1), the Oak Ridge Reservation would receive only HEU from the Idaho National Engineering Laboratory and/or the Savannah River Site. The amount of spent nuclear fuel would be approximately 4.6 MTHM, representing 11,200 elements. The impacts from the management of this amount of fuel at the Oak Ridge Reservation would be bounded by analysis option 4A above.

- Under Implementation Subalternative 1c (Section 2.2.2.1), the Oak Ridge Reservation would receive target material in addition to the foreign research reactor spent nuclear fuel considered under the basic implementation of Management Alternative 1. The analysis assumes that the receipt and management of this material, which represents in uranium content approximately 620 typical foreign research reactor spent nuclear fuel elements, would increase the impacts of analysis option 4A by a small percentage.

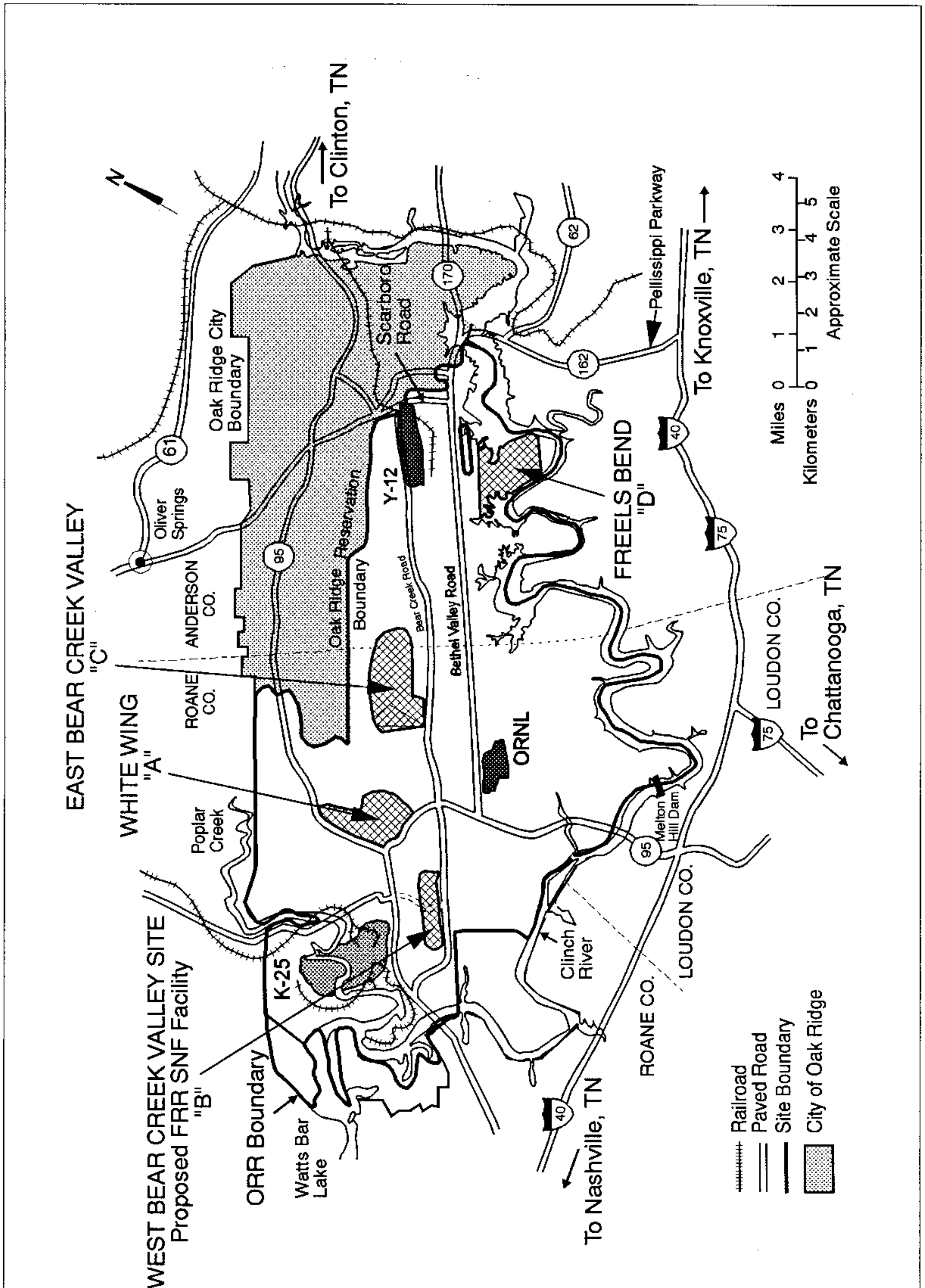


Figure 2-17 Candidate Sites at the Oak Ridge Reservation for Foreign Research Reactor Spent Nuclear Fuel Storage

- Under Implementation Subalternative 2a (Section 2.2.2.2), the duration of the policy would be decreased to 5 years; and, therefore, the amount of spent nuclear fuel available for management would also be decreased. In this case, the Oak Ridge Reservation would receive all foreign research reactor spent nuclear fuel from the Savannah River Site and/or the Idaho National Engineering Laboratory. The impacts from the management of the decreased amount of spent nuclear fuel at the Oak Ridge Reservation would be bounded by analysis option 4A above.

- Under Implementation Subalternative 2b (Section 2.2.2.2), the acceptance of a small portion of the spent nuclear fuel would be extended over an indefinite period of time, but the amount of spent nuclear fuel to be received and managed would remain constant. The impacts would be the same as in option 4A.

- Under Implementation Alternative 3 (Section 2.2.2.3), DOE and the Department of State would consider alternative financial arrangements. These arrangements would affect the amount of spent nuclear fuel that would be managed in the United States as the foreign research reactors would consider their own alternatives on whether to send the spent nuclear fuel to the United States. The amount of spent nuclear fuel in this case cannot be quantified; however, the upper limit, which is considered under analysis option 4A, would be bounding.

- Under Implementation Alternative 4 (Section 2.2.2.4), DOE and the Department of State would consider alternatives for the location where title of the foreign research reactor spent nuclear fuel would be taken. The choices do not affect the management options at the Oak Ridge Reservation.

- Under Implementation Alternative 5 (Section 2.2.2.5), DOE would consider construction of a new wet storage facility at the Oak Ridge Reservation for Phase 2 until ultimate disposition. For this implementation alternative an analysis option 4B, which is similar to 4A, is considered as follows:

4B. The spent nuclear fuel managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 would be shipped to the Oak Ridge Reservation where it would be managed at a new wet storage facility. Spent nuclear fuel arriving in the United States after Phase 1 concludes (i.e., during Phase 2) would also be received and managed at the new facility until ultimate disposition. For the purposes of analysis, the total amount of spent nuclear fuel to be managed in the wet storage facility would be all the foreign research reactor spent nuclear fuel (22,700 elements).

- Under Implementation Alternative 6 (Section 2.2.2.6), DOE and the Department of State would consider chemical separation of foreign research reactor spent nuclear fuel in the United States. Based on the discussion in Section 2.3.6, the Oak Ridge Reservation would not be considered as a site for chemical separation. The Oak Ridge Reservation is also not considered under the Hybrid Alternative discussed in Section 2.4.

Table 2-14 presents an overview of the foreign research reactor spent nuclear fuel management options, quantities of foreign research reactor spent nuclear fuel assumed for the analysis, and facilities considered.

Table 2-14 Proposed Quantities of Foreign Research Reactor Spent Nuclear Fuel and Management Options at Oak Ridge Reservation

Management Alternative 1		*FRR SNF Elements*	*Percentage of Total FRR SNF Elements*	*Storage Option/Technology*	
				Dry Storage (New)	*Wet Storage (New)*
All FRR SNF	Phase 2[a]	22,700	100%	A	A
Eastern FRR SNF	Phase 2	16,400	72%	A	A
Aluminum-based FRR SNF	Phase 2	17,800	78%	A	A

A = Applicable
FRR = foreign research reactor
SNF = spent nuclear fuel
[a] *Phase 2 values represent total number of foreign research reactor spent nuclear fuel elements requiring management at the site.*

2.6.5.3.5 The Nevada Test Site

The options for receiving and managing foreign research reactor spent nuclear fuel at the Nevada Test Site are primarily dictated by the Programmatic SNF&INEL Final EIS (DOE, 1995c) alternatives, and the lack of suitable facilities at the Nevada Test Site to receive foreign research reactor spent nuclear fuel at the beginning of the proposed policy period.

If the Nevada Test Site is the site to manage DOE-owned spent nuclear fuel under the Programmatic SNF&INEL Final EIS, foreign research reactor spent nuclear fuel would be received and managed first at the Savannah River Site and/or the Idaho National Engineering Laboratory for the period (Phase 1) required for the Nevada Test Site to have new facilities constructed and operational to accommodate the spent nuclear fuel. As discussed in previous sections, Phase 1 is estimated to be about 10 years. At the end of Phase 1 (i.e., start of Phase 2) the Nevada Test Site would be able to receive and manage foreign research reactor spent nuclear fuel that would be shipped from the Savannah River Site and/or the Idaho National Engineering Laboratory and directly from the ports for those shipments made after Phase 1 concludes. Management of the foreign research reactor spent nuclear fuel would continue at the Nevada Test Site until ultimate disposition.

Although the Nevada Test Site has no existing facilities to receive foreign research reactor spent nuclear fuel at the beginning of the management period, it has facilities that could be modified to receive foreign research reactor spent nuclear fuel within 5 years. These facilities are large hot cells located in the Nevada Research and Development Area on Jackass Flats. Presently these facilities (e.g., the Engine Maintenance and Disassembly [E-MAD] facility) have little usage, but some are in acceptable condition. To use the E-MAD facility, a small pool would have to be constructed to be used for transferring the spent nuclear fuel from the transportation casks to containers designed for dry storage. A description of the E-MAD facility is included in Appendix F (Section F.1). The E-MAD facility could be ready within 5 years of the start of the proposed policy period.

The amount of spent nuclear fuel that would be received and managed at the Nevada Test Site under the basic implementation of Management Alternative 1, is dictated by the distribution considered in the Programmatic SNF&INEL Final EIS (DOE, 1995c). Accordingly, during Phase 2, the Nevada Test Site could receive TRIGA foreign research reactor spent nuclear fuel managed at the Idaho National Engineering Laboratory during Phase 1, only Western foreign research reactor spent nuclear fuel under the Regionalization By Geography alternative, or all foreign research reactor spent nuclear fuel under the Centralization alternative.

As a Phase 2 site, the Nevada Test Site would receive and manage foreign research reactor spent nuclear fuel at a newly constructed dry storage facility or a modified E-MAD facility. Description of the new dry storage facility is provided in Section 2.6.5.1.1. Figure 2-18 displays the potential construction location and the area where the E-MAD facility is located at the Nevada Test Site.

The analysis of potential environmental impacts from management of foreign research reactor spent nuclear fuel at the Nevada Test Site is based on the above considerations. The analysis options selected do not represent all possible combinations, but a reasonable set that provides a typical, and in some cases, bounding estimate of the resulting impacts.

The specific analysis option under the basic implementation of Management Alternative 1, discussed in Section 2.2.1, is as follows:

5A. The spent nuclear fuel managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 would be shipped to the Nevada Test Site where it would be managed at a new dry storage facility or a modified E-MAD facility. Spent nuclear fuel arriving in the United States after Phase 1 concludes (i.e., during Phase 2) would also be received and managed at the new or E-MAD facility until ultimate disposition. For the purposes of the analysis, the total amount of spent nuclear fuel that would be stored would be all the foreign research reactor spent nuclear fuel (22,700 elements).

The implementation alternatives of Management Alternative 1, discussed in Section 2.2.2, introduce additional analysis options that could be considered for the Nevada Test Site as follows:

- Under Implementation Subalternative 1a (Section 2.2.2.1), the amount of spent nuclear fuel to be received in the United States would be reduced to 5,000 elements. In this case, the Nevada Test Site would receive the foreign research reactor spent nuclear fuel from the Idaho National Engineering Laboratory or the Savannah River Site and manage it in facilities sized for the reduced amount. The impacts from the management of this amount of spent nuclear fuel would be bounded by analysis option 5A.

- Under Implementation Subalternative 1b (Section 2.2.2.1), the Nevada Test Site would receive from the Idaho National Engineering Laboratory and/or the Savannah River Site only HEU. The amount of HEU would be approximately 4.6 MTHM, representing 11,200 elements. The impacts from the management of this amount of fuel would be bounded by analysis option 5A above.

- Under Implementation Subalternative 1c (Section 2.2.2.1), the Nevada Test Site would receive target material in addition to the foreign research reactor spent nuclear fuel considered under the basic implementation of Management Alternative 1. The receipt and management of this material, which represents in uranium content approximately 620 typical foreign research reactor spent nuclear fuel elements, would increase the impacts of analysis option 5A by a small percentage.

- Under Implementation Subalternative 2a (Section 2.2.2.2), the duration of the policy would be decreased to 5 years; and, therefore, the amount of spent nuclear fuel available for management would also be decreased. In such a case, the Nevada Test Site would receive all foreign research reactor spent nuclear fuel from the Savannah River Site and/or the

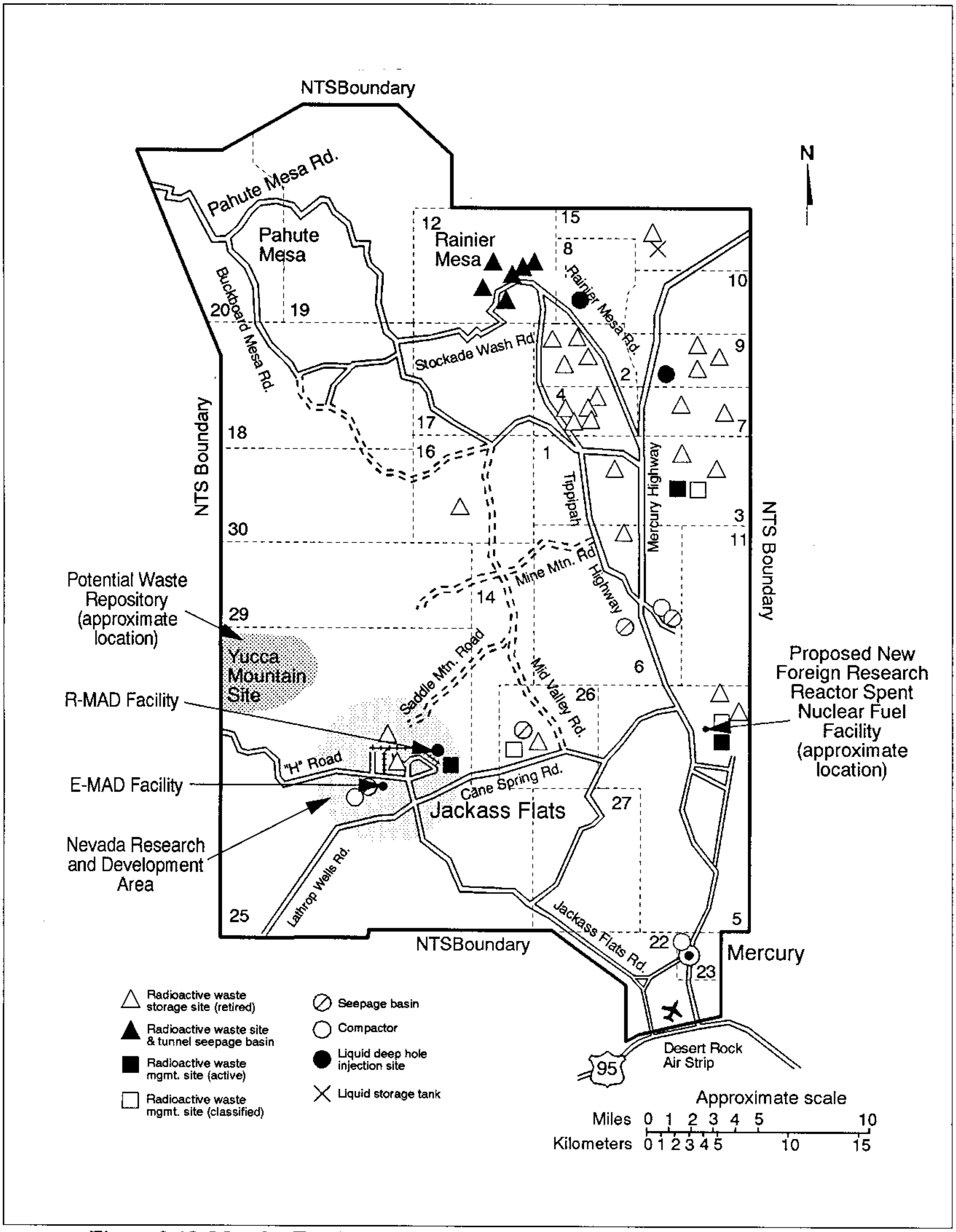


Figure 2-18 Map for Foreign Research Reactor Spent Nuclear Fuel Storage at the Nevada Test Site

Idaho National Engineering Laboratory. The impacts from the management of the decreased amount of spent nuclear fuel at the Nevada Test Site would be bounded by analysis option 5A above.

- Under Implementation Subalternative 2b (Section 2.2.2.2), the acceptance of a small portion of the spent nuclear fuel would be extended over an indefinite period of time, but the amount of spent nuclear fuel to be received and managed would remain constant. The impacts would be the same as in analysis option 5A.

- Under Implementation Alternative 3 (Section 2.2.2.3), DOE and the Department of State would consider alternative financial arrangements. The various arrangements would affect the amount of spent nuclear fuel that would be managed in the United States as the foreign research reactors would consider their own alternatives on whether to send the spent nuclear fuel to the United States. The amount of spent nuclear fuel in this case cannot be quantified; however, the upper limit, considered under analysis option 5A, would be bounding.

- Under Implementation Alternative 4 (Section 2.2.2.4), DOE and the Department of State would consider alternatives for the location where title of foreign research reactor spent nuclear fuel would be taken. The choices do not affect the management options at the Nevada Test Site.

- Under Implementation Alternative 5 (Section 2.2.2.5), DOE would consider construction of a new wet storage facility at the Nevada Test Site for Phase 2 until ultimate disposition. For this implementation alternative an analysis option 5B, which is similar to 5A, is considered as follows:

5B. The spent nuclear fuel managed at the Idaho National Engineering Laboratory and/or the Savannah River Site during Phase 1 would be shipped to the Nevada Test Site where it would be managed at a new wet storage facility. Spent nuclear fuel arriving in the United States after Phase 1 concludes (i.e., during Phase 2) would also be received and managed at the new facility until ultimate disposition. For the purposes of analysis, the total amount of spent nuclear fuel that would be managed in the wet storage facility would be all the foreign research reactor spent nuclear fuel (22,700 elements). If the Nevada Test Site were to receive only TRIGA spent nuclear fuel from the Idaho National Engineering Laboratory or only western spent nuclear fuel, the wet storage facility would be sized accordingly. The impacts from a smaller size facility would be bounded by the option analyzed.

- Under Implementation Alternative 6 (Section 2.2.2.6), DOE and the Department of State would consider chemical separation of foreign research reactor spent nuclear fuel in the United States. Based on the discussion in Section 2.3.6, the Nevada Test Site would not be considered as a site for chemical separation. The Nevada Test Site is also not considered for the Hybrid Alternative discussed in Section 2.4.

Table 2-15 presents an overview of the foreign research reactor spent nuclear fuel management options, quantities of foreign research reactor spent nuclear fuel assumed for the analysis, and facilities considered.

Table 2-15 Proposed Quantities of Foreign Research Reactor Spent Nuclear Fuel and Management Options at the Nevada Test Site

Management Alternative 1		*FRR SNF Elements*	*Percentage of Total FRR SNF Elements*	*Storage Option/Technology*		
				Dry Storage		*Wet Storage*
				E-MAD[a]	*New*	*New*
All FRR SNF	Phase 2[b]	22,700	100%	A	A	A
Western FRR SNF	Phase 2	6,300	28%	A	A	A
TRIGA FRR SNF	Phase 2	4,900	22%	A	A	A

A = Applicable
NA = Not Applicable
FRR = foreign research reactor
SNF = spent nuclear fuel

[a] *E-MAD could be available for use five years after the start of implementation.*

[b] *Phase 2 values represent total number of foreign research reactor spent nuclear fuel elements requiring management at the site.*

2.7 Characteristics of Emergency Management and Response

This section addresses the emergency management and response infrastructure that exists to support the possible implementation of those management alternatives of the proposed action that would have an impact in the United States. This section considers emergency management and response at the ports of entry, along ground transport routes, and at the management sites.

2.7.1 DOE and the National Response System

In the United States, State and local governments are responsible for emergency management and response programs. These programs must be capable of managing all hazards ranging from natural disasters to hazardous material incidents on a day-to-day basis. In order to maintain these programs, various State, Tribal, and local governments receive Federal funding. DOE historically has provided a variety of support to governmental jurisdictions in fulfilling its responsibilities under regulatory and National emergency plan taskings (FEMA, 1994; Rogoff, 1994; and DOE, 1994g).

There are three national emergency response plans (i.e., Federal Response Plan, Federal Radiological Emergency Response Plan, and the National Contingency Plan) under which DOE provides radiological monitoring and assessment assistance. Under these plans, DOE provides technical advice and assistance to State, Tribal, and local agencies involved with a radiological incident (DOE, 1989). For a foreign research reactor spent nuclear fuel incident, DOE actions would be guided by the Federal Radiological Emergency Response Plan (FEMA, 1985) and its own internal emergency management and response system.

DOE maintains an emergency management and response system that is based on regulatory requirements as outlined in various DOE Orders (e.g., DOE Order Series 5500 and 5530). These orders require an emergency management and response system that generally follows the models and practices established by the Federal Emergency Management Agency, National Fire Protection Association, American National Standards Institute, and National Council on Radiation Protection and Measurements.

2.7.2 Foreign Research Reactor Spent Nuclear Fuel Transportation

Foreign research reactor operators, their shipping agents, and commercial carriers would have the primary responsibility to coordinate and arrange all activities associated with foreign research reactor spent nuclear fuel shipments and cask return including emergency management and response. DOE, along with other Federal agencies (e.g., Department of Transportation, NRC, Federal Emergency Management Agency, U.S. Department of Defense, and the U.S. Environmental Protection Agency) would provide support and assistance to State, Tribal, and local government agencies responsible for responding to a foreign research reactor spent nuclear fuel incident.

DOE fulfills its role and responsibilities as the Federal agency tasked with developing and maintaining a capability to safely manage spent nuclear fuel (DOE, 1995c), in part by setting overall spent nuclear fuel program management responsibility and policy for transportation and emergency management and response; resolving policy questions; issuing guidance; providing information; and accomplishing oversight by including regulatory compliance requirements in its spent nuclear fuel related contracts and by monitoring the performance of those involved.

According to DOE records, from 1985 to 1993 there were 102,213 DOE shipments consisting of 1,009,357.6 metric tons (1,112,626 tons) of radioactive material. Of these, 457 shipments, containing 13,176.86 metric tons (14,525 tons) were spent nuclear fuel (these weights include the packaging) (DOE, 1994d). To date, there are no records of radiological fatalities that have occurred in the United States due to transportation accidents. To date, no spent nuclear fuel transportation cask has ever been punctured or released any of its radioactive contents, even in actual highway accidents (NRC, 1993).

2.7.3 External Coordination

Historically, DOE ensures coordination with various organizations and agencies through its interaction with Government, national, and local groups such as the Southern States Energy Board and Western Governors' Association, among others.

The primary responsibility for developing and maintaining a radiological hazardous materials emergency response capability is vested in State, Tribal, and local agencies. DOE, on an "as needed," case-by-case basis, has helped State, Tribal, and local agencies prepare for response to potential accidents involving DOE radioactive material shipments (including spent nuclear fuel). As with the Urgent Relief foreign research reactor spent nuclear fuel transportation effort, DOE has offered various types of technical assistance to the affected jurisdictions (SSEB, 1994).

One example of this partnership with State and local governments occurred in August 1994. In support of Urgent Relief safe transportation, special Radiological Emergency Training for Local Responders and Emergency Response Workshop courses were conducted by DOE for approximately 160 local responders from North Carolina and South Carolina (Analysas Corporation, 1994).

2.7.3.1 Financial and Technical Assistance to States and Tribes

DOE provides funding to States and Tribes through the Office of Environmental Management and the Office of Civilian Radioactive Waste Management to assist with transportation related issues. While some of these funding efforts are not directly related to spent nuclear fuel shipments, they do enhance a jurisdiction's emergency management and response capabilities (DOE, 1994g). Financial assistance to States and Tribes for Transportation programs for fiscal year 1994 is shown in Table 2-16 (DOE, 1994g).

Table 2-16 DOE Summary of Financial Assistance to States and Indian Tribes

Total Allocations for Transportation Programs: FY 1994	
Activity	***Amount***
Waste Isolation Pilot Plant	$1,410,848
Cesium Shipment Support	330,000
Spent Fuel Shipment Support	125,000
Transportation External Coordination Working Group[a]	34,921
Urban Energy & Transportation Corporation[b]	150,137
Office of Civilian Radioactive Waste Management	1,332,000
State of Washington Emergency Management Funds	637,570
Total Allocations	**$4,020,476**

[a] *The amount shown reflects the cost to DOE of furnishing travel, food, and lodging for non-DOE participants at two Transportation External Coordination meetings. Participation in Transportation External Coordination meetings is not restricted to States and Tribes; however, it is not possible to break out State and Tribal costs separately.*

[b] *The amount shown reflects the cost to DOE of furnishing travel, food and lodging for non-DOE participants at three Urban Energy & Transportation Corporation meetings. Urban Energy & Transportation Corporation is a non-profit corporation organized primarily to address local government concerns.*

Besides funding, much of DOE's assistance is provided in the form of technical assistance, for which DOE bears the cost. Assistance may be provided through DOE's Radiological Assistance Program and under the National Contingency Plan, as well as through training, DOE sponsored meetings, informal discussions, and informational materials (DOE, 1994g).

2.7.3.2 Training Assistance to States and Tribes

State, Tribal, local personnel, and other Federal agencies participate in training programs developed by DOE for its staff and contractors. State, Tribal, and local personnel pay their own travel and per diem expenses; however, DOE bears the cost of developing and implementing the training. Available training includes:

- Hazardous Waste Transportation and Packaging Workshop which covers regulations governing transportation of radioactive materials;
- Radiological Emergency Response and Operations is offered in conjunction with the Federal Emergency Management Agency, and teaches response to and management of radiological incidents;
- Radiological Emergency Training for Local Responders was piloted during fiscal year 1994 in Wyoming and brings training directly to the states, allowing them to train in their own environment;
- Radioactive Material Response Orientation provides a 1-day introduction for response personnel;
- Advanced Radioactive Materials Transportation Accident Response is a sequel to the previous course for State, Tribal, Regional, and local emergency responders; and

- Transportation Emergency Training for Response Assistance includes several modules. The Public Affairs module, which is specifically designed to include States and Tribes, is scheduled for piloting during Fiscal Year 1995 (DOE, 1994g).

In addition, the DOE-funded Radiation Emergency Assistance Center/Training Site located in Oak Ridge, Tennessee, conducts courses in medical management of radiation emergencies. These courses include:

- Handling of Radiation Accidents by Emergency Personnel;
- Medical Planning and Care in Radiation Accidents;
- Health Physics in Radiation Accidents; and
- Occupational Health in Nuclear Facilities (REACT/TS, n.d.a.).

2.7.3.3 Transportation External Coordination/Working Group

DOE recognizes the need for ongoing partnerships with external organizations: health and safety; emergency management and response; law enforcement; technical; State, Tribal, and local government; and industrial organizations involved in radiological emergency response. This "stakeholder" involvement has been formalized in the Transportation External Coordination/Working Group.

The Transportation External Coordination/Working Group (Table 2-17) is a 35 member body of emergency management and response professional associations (DOE, 1994i). Through this group DOE looks at crosscutting transportation and emergency response issues that all DOE programs either are addressing or will address in the future. In turn, these groups are able to provide input to DOE for its decision-making process involving these issues (Holm, 1994).

2.7.3.4 Transportation Emergency Preparedness Program

The Transportation Emergency Preparedness Program helps integrate DOE's existing emergency management and response capabilities into an effective response system for transportation incidents involving DOE shipments. Through its extensive external coordination program with State, Tribal, and local agencies, DOE develops interfaces for meeting its various national response plan taskings to provide radiological monitoring and assessment technical assistance needed for transportation incidents involving radioactive materials including any possible incidents associated with a foreign research reactor spent nuclear fuel shipment.

Under the Transportation Emergency Preparedness Program Field Assistance Program, DOE provides support for emergency exercises (Table 2-18) that include State, Tribal, and local agencies through the Operations Offices (DOE, 1994g; DOE, 1994n; SSEB, 1994).

2.7.3.5 Radiological Assistance Program

The primary DOE response groups that would assist at a foreign research reactor spent nuclear fuel incident are the Radiological Assistance Program teams that operate from eight strategically located DOE Regional Coordinating Offices (Figure 2-19) around the country. These teams, upon State, Tribal, or local jurisdiction request, provide technical expertise and assistance to monitor and assess radiological hazards. Figure 2-19 displays pertinent information for contacting each regional office.

Table 2-17 Transportation External Coordination/Working Group Membership

Invited Organizations	*Guest Organizations*[c]
American Association of State Highway and Transportation Officials[a]	Emergency Services Representatives
American College of Emergency Physicians	Arizona Division of Emergency Services
AFL-CIO Transportation Trades Department[a]	City of Jacksonville, FL, Fire Department
American Indian Law Center[a]	Louisiana State Police/TESS
American Trucking Association[a]	St. Charles Parish Department of Emergency Management
Association of American Railroads	Ohio Emergency Management Agency
Chemical Manufacturers Association[b]	County Representatives
Columbia River Inter-tribal Fish Commission	Transportation Advisor, Nuclear Waste Project, Carson City, NV
Commercial Vehicle Safety Alliance	Clark County Comprehensive Planning Department, Esmeralda, NV
Conference of Radiation Control Program Directors	Transportation Planner, Nuclear Waste Division, Las Vegas, NV
Cooperative Hazardous Materials Enforcement Development[a]	Mineral County Office of Nuclear Projects, Hawthorne, NV
Council of Energy Resource Tribes	Nye County, NV
Council of State Governments, Midwestern Office	Nye County Nuclear Waste Repository Office, Tonopah, NV
Edison Electric Institute	White Pine County, NV
Emergency Nurses Association	White Pine County Nuclear Waste Project Office, Ely, NV
Hazardous Materials Advisory Council[a]	Tribal Representatives
International Association of Chiefs of Police	Manager, ERWM Program, Nez Perce Tribe, Lapwai, ID
International Association of Fire Chiefs	Industry Representatives
International Association of Fire Fighters	Union Pacific Railroad
International City Management Association[a]	Environmental Evaluation Group
National Association of Counties	PIC
National Association of Emergency Medical Technicians	
National Association of Regulatory Utility Commissioners[a]	
National Conference of State Legislators	
National Conference of State Transportation Specialists[a]	
National Congress of American Indians	
National Coordinating Council on Emergency Management	
National Emergency Management Association	
National Governors' Association[a]	
National Indian Policy Center	
National League of Cities[a]	
Southern States Energy Board	
Urban Energy and Transportation Corporation	
Western Governors' Association	
Western Interstate Energy Board	

[a] *Denotes organizations invited to attend, but have not yet participated.*

[b] *Denotes organizations invited to attend, but do not wish to participate.*

[c] *Denotes organizations who have attended Transportation External Coordination/Working Group meetings, but are not full-time members.*

Table 2-18 Radiological Emergency Response Exercises

Exercise	Location	Date
TRANSAX 1994	Ontario, OR	August 3, 1994
TRANSAX 1993	Lamy, NM	September 1, 1993
TRANSAX 1992	Fort Hall, ID	September 16, 1992
TRANSAX 1990	Colorado Springs, CO	November 8, 1990
WIPPTREX 93-1	Laramie, WY	April 14, 1993
WIPPTREX 92-1	Raton, NM	October 28, 1992

Radiological Assistance Program teams are composed of a range of technical specialists who volunteer for team membership. The teams are activated on an "as needed" basis and generally can be ready to deploy from their home station within 4 hours of notification. Response times to the scene vary depending on the accident's location and the level of assistance required (Taylor, 1995).

In 1994, Radiological Assistance Program teams responded 37 times to a variety of radiological situations throughout the country. Upon evaluation, a number of these responses were determined to be nonradiological hazards (Taylor and Hauptman, 1994).

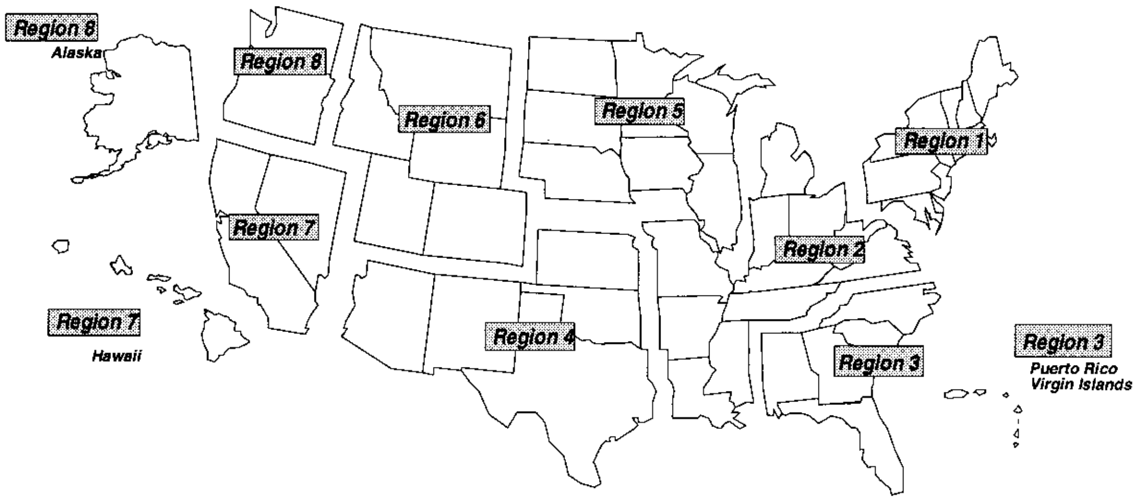
Typically, Radiological Assistance Program teams are involved in identifying personnel, equipment, or property that may be radiologically contaminated, recommending sources of medical advice for the treatment of personal injuries sustained as a result of exposure to radioactivity, and providing advice or assistance in monitoring, decontamination, material recovery, or other post-emergency operations (Gordon-Hagerty, 1993).

2.7.4 Emergency Management and Response at Ports of Entry

From 1979 to 1992, 317 spent nuclear fuel shipments in "Type B" transportation casks were made through various United States ports (NRC, 1993) with no releases of radioactive materials. The "Type B" cask shipments were placed in standard maritime shipping containers the same as any other material being sent to the port. Foreign research reactor spent nuclear fuel shipments are subject to the same types of potential hazards as those of other ships carrying nonradioactive hazardous materials.

Under the Oil Spill Prevention Act of 1990, each port is required to develop an Area Contingency Plan. While the main focus of these plans is an oil spill response, they have been expanded in many cases to address other types of hazardous material responses including radioactive material. These plans outline response capabilities, procedures, and authorities for responding to and recovering from hazardous material incidents.

These ports of entry have a specially designated and prepared terminal or dock area for unloading hazardous materials. They have either a dedicated hazardous material response team or access to a local team through some type of mutual aid agreement. These emergency response teams receive ongoing training and participate in various types of drills and exercises. Also, the dock workers receive varying levels of ongoing hazardous materials response training.



Regional Coordinating Office	Mailing Address	Telephone for Assistance
1. ***Brookhaven National Laboratory***	Upton, Long Island New York 11973	(516) 282-2200 24 Hours
2. ***Oak Ridge Operations Office***	DOE EOC M/S DP 801, P.O. Box 2001 200 Administration Road Oak Ridge, TN 37831-8543	(615) 576-1005 24 Hours
3. ***Savannah River Operations Office***	P.O. Box 616 Aiken, SC 29808	(803) 725-3333 24 Hours
4. ***Albuquerque Operations Office***	P.O. Box 5400 Albuquerque, NM 87185-5400	(505) 845-4667 24 Hours
5. ***Chicago Operations Office***	9800 S. Cass Avenue Argonne, IL 60439	Duty Hours: (708) 252-4800 Off Hours: (708) 252-5731
6. ***Idaho Operations Office***	850 Energy Drive Idaho Falls, ID 83401-1563	(208) 526-1515 24 Hours
7. ***Oakland Operations Office***	1301 Clay Street Oakland, CA 94612	(510) 637-1794 24 Hours
8. ***Richland Operations Office***	825 Jadwin Avenue Richland, WA 99352	(509) 373-3800 24 Hours
9. ***DOE Headquarters EOC***	1000 Independence Avenue Washington, DC 20585	Non-Emergency: (202) 586-8100 Emergency: (202) 586-8500

Figure 2-19 DOE Regional Coordinating Offices for Radiological Assistance and Their Geographical Areas of Responsibility

The U.S. Coast Guard Captain of the Port would have primary On-Scene Coordinator responsibility during a foreign research reactor spent nuclear fuel incident/accident at the port, and would work in conjunction with emergency responders from the Port Authority and local jurisdictions. The On-Scene Coordinator also would be able to call upon a wide range of U.S. Coast Guard resources and the resources of other Federal agencies.

On-Scene Coordinators have at their disposal the resources of the staff of the Marine Safety Office, the resources of the staff at U.S. Coast Guard Headquarters in Washington, DC, assets of any Boat Stations in the Marine Safety Office zone, and any Air Groups. The Marine Safety Office or a Port Authority facility is used as the Emergency Operations Center for many incidents. The On-Scene Coordinator has the authority to call in the Strike Team.

These Strike Teams have limited responsibilities in the course of an incident. Their two main duties are containment and clean-up. They use booms, skimmers, absorbents, and chemicals in their response. The vessels used as platforms for booms and skimmers are usually provided by the Marine Safety Office or Boat Station in the area of the incident. Strike Teams consist of highly trained pollution response and clean-up personnel.

There are three Strike Teams under the command of the National Strike Force Coordination Center in Elizabeth City, NC, that could be called on for a foreign research reactor spent nuclear fuel accident. These teams are located on the three coasts of the United States: the Gulf Strike Team located in Mobile, AL; the Pacific Strike Team located in Novato, CA; and the Atlantic Strike Team located in Fort Dix, NJ.

For a foreign research reactor spent nuclear fuel accident, the U.S. Coast Guard On-Scene Coordinator would request an NRC or DOE representative. DOE Radiological Assistance Program teams would be requested as needed.

2.7.5 Emergency Management and Response Along Ground Transport Routes

During transport of the spent nuclear fuel received as a result of the Urgent Relief Acceptance of Foreign Research Reactor Spent Nuclear Fuel Environmental Assessment, the foreign research reactor operator's shipping agents were required to ensure that all activities of the agent's and the commercial carrier's personnel conformed to regulatory requirements, as well as all plans and procedures developed for the foreign research reactor spent nuclear fuel (DOE, 1994m). DOE and other Federal and State government agencies monitored the activities of the shipping agent and the commercial carrier to ensure that the regulatory requirements were met. If foreign research reactor spent nuclear fuel is managed in the United States, DOE will prepare a Transportation Plan before any shipments are undertaken. The Transportation Plan will detail all transportation activities necessary for the safe and secure transport of the foreign research reactor spent nuclear fuel from the point of origin to the management site in the United States. The general provisions for such a plan are included in Appendix H.

Primary responsibility for emergency response to a foreign research reactor spent nuclear fuel incident would reside with local authorities (DOE, 1989). Each corridor State or Tribe would be responsible for augmenting their existing emergency management and response plans and procedures with any foreign research reactor spent nuclear fuel specific information they felt was necessary.

States coordinate with their local jurisdictions on emergency planning and information. States and Tribes would be responsible for notifying DOE of any conditions that could affect the safe and secure transport of foreign research reactor spent nuclear fuel shipments through their jurisdictions. DOE would provide technical advice and assistance to the shippers and affected government jurisdictions to ensure safe transportation.

Spent nuclear fuel shipments transported by rail, barge, or commercial truck carrier would be subject to the same potential problems as any other hazardous materials shipment that travels daily by these means, namely severe weather, mechanical problems, derailments, and collisions.

DOE would seek to mitigate potential highway foreign research reactor spent nuclear fuel accident consequences by ensuring commercial carriers comply with NRC guidelines for shipment security and the Department of Transportation Highway Route Controlled Quantity routing regulations (DOE, 1995c) which are designed to reduce radiological transportation risk impacts.

The rail and barge industries are similar to the trucking industry in the hazardous material transportation regulatory regime. Documentation, manifesting, placarding, labeling, and other communications are controlled by 49 CFR Parts 100-199.

The carriers used for the transportation of foreign research reactor spent nuclear fuel would be required to develop emergency response plans. In developing these plans, the carriers would be required to consider the following responsibilities:

- protect life, health, and the environment;
- notify appropriate railroad officials in a timely manner;
- notify the appropriate Federal, State, and local authorities, and the shipper;
- initiate a prompt and proper response;
- provide appropriate resources and expertise for resolution of the incident;
- perform cleanup functions; and
- establish and maintain a working contact with the responsible Governmental authorities until they declare the incident closed.

As discussed in Section 2.7.2, spent nuclear fuel shipments, like other hazardous material shipments, have been involved in transportation accidents. Those that have occurred have not resulted in a radiological hazard or damage to the public or the environment. This is primarily due to the rigorous packaging.

Each State and Tribe along a shipping route would be notified of the foreign research reactor spent nuclear fuel shipment's itinerary through that jurisdiction to enable the appropriate agencies to notify the necessary response personnel. Also, DOE would maintain continuous communications through its communications and tracking systems (DOE, 1989).

Foreign research reactor spent nuclear fuel shipments would be tracked either by the commercial carrier or by a satellite tracking system similar to DOE's Transportation Tracking and Communications System (Figure 2-20). The satellite tracking system would provide a "real-time" satellite tracking and voice communications system that would link the truck or train and its escorts with a control center. Some commercial carriers have established their own satellite tracking systems. The DOE system would interface with these systems and co-monitor the shipment's progress to ensure maximum accountability and security. The satellite tracking system would also coordinate "SAFE PARKING" requests from the states.

If a situation would arise (e.g., severe weather, mechanical difficulties, protesters, security threat, personnel illness or injury) that presented a hazard or threat to a highway foreign research reactor spent nuclear fuel shipment, DOE would have arranged through Memoranda of Agreement for the commercial carrier to divert to any Federal installation (e.g., a DOE site or military base) and request "SAFE PARKING" at that facility until the situation is resolved. The receiving facility would assist in providing security and logistical support until the shipment was prepared to depart.

State, Tribal, and local agencies, as well as the commercial carriers, maintain various emergency response plans and procedures. During a foreign research reactor spent nuclear fuel highway, barge, or rail accident, the personnel accompanying the shipment would be the immediate contact for information to the local emergency responders having jurisdiction and Incident Commander authority over the situation.

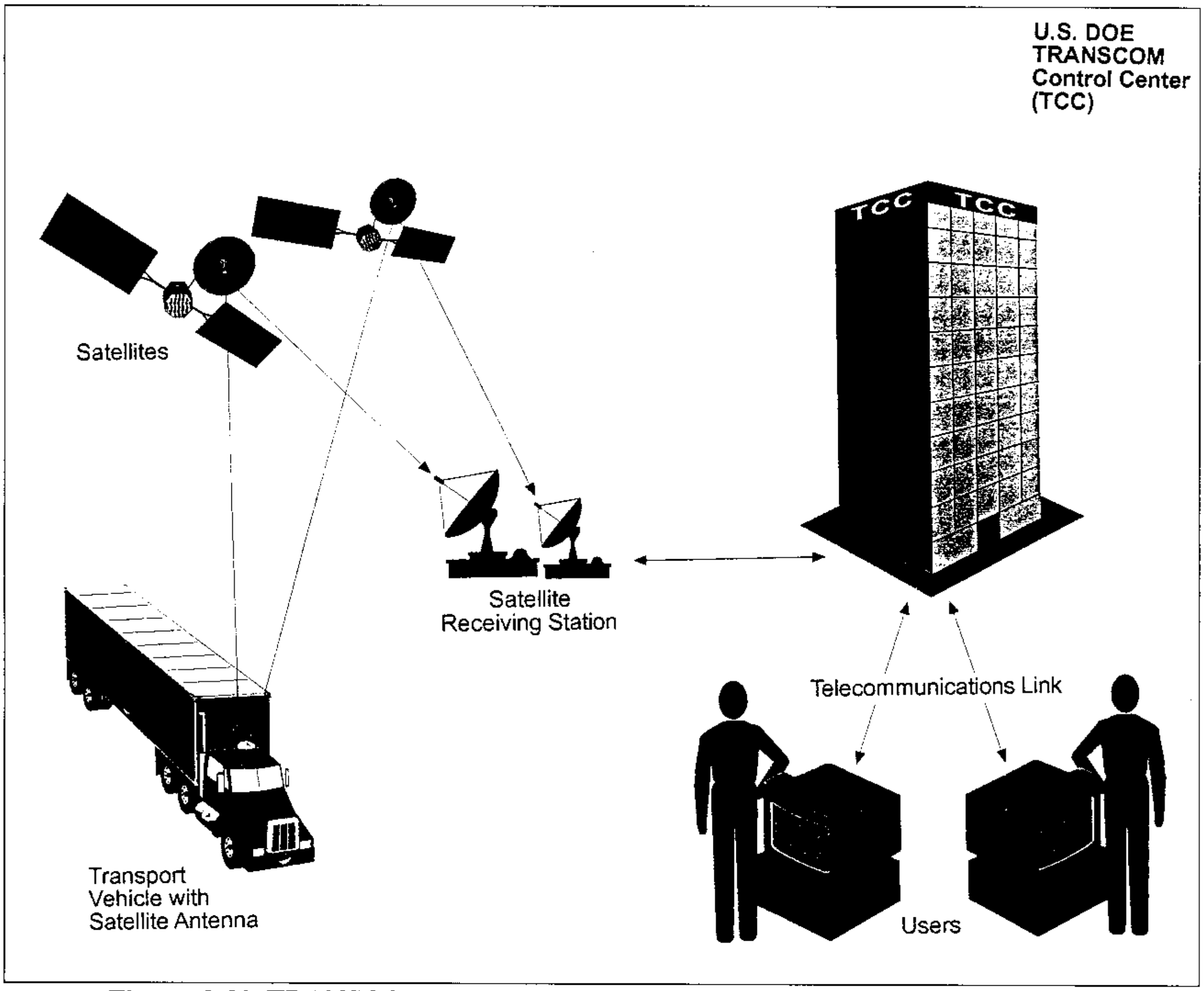


Figure 2-20 TRANSCOM, DOE's Transportation Tracking and Communications System

Additionally, the Hazardous Material Regulations (49 CFR 177.861) advise highway shippers, carriers, and emergency responders to contact DOE if assistance with radioactive materials is required (DOE, 1990b). A DOE Radiological Assistance Program team could respond to the scene if requested.

Incident Commanders have other sources of technical assistance they could call on such as the commercial carrier's technical experts (through a 24-hr contact number), the National Response Center, and the Chemical Transportation Emergency Center, which provides immediate response advice and information from the shipper on a 24-hr basis.

2.7.6 Emergency Management and Response at Management Sites

The DOE 5500 series of Orders incorporates various Federal regulatory requirements and mandates an extensive emergency management and response program at each management site in the same manner as any other industrial facility or local government jurisdiction. State-level specific requirements are addressed by each respective site.

Each of these sites routinely handles hazardous materials that have potential emergency management and response considerations similar to foreign research reactor spent nuclear fuel. These, along with the usual risks posed by any industrial environment, are regularly evaluated through various Safety Analysis Reports and Hazards Assessment studies. These situations are then mitigated to the greatest extent possible.

2.8 Security Measures

Domestic transportation of foreign research reactor spent nuclear fuel would be under the regulatory jurisdiction of the U.S. Department of Transportation and NRC. In the event that foreign research reactor spent nuclear fuel were to be transported through a military port of entry, applicable requirements would be established in advance by the U.S. Department of Defense, DOE and NRC to provide the appropriate level of security.

The objective of the security measures during transportation of spent nuclear fuel are to minimize the possibilities for radiological sabotage of spent nuclear fuel shipments and facilitate the location and recovery of spent nuclear fuel shipments that may have come under control of unauthorized persons. The elements of the security measures would be considered when developing the Transportation Plan to be developed by DOE in consultation with State, local, and Tribal officials prior to any actual spent nuclear fuel shipments. The general provisions of the Transportation Plan, which would include requirements relative to emergency response planning, security considerations, and communications during actual shipments of foreign research reactor spent nuclear fuel, are included in Appendix H.

The security measures provided by the regulations would make the hijacking of a transportation cask a highly unlikely event. In the first place, the large size and weight of these casks (9.1 to 22.7 metric tons, or 10 to 25 tons) and the inherent radioactivity of the spent nuclear fuel make spent fuel in a transportation cask an unlikely hijacking target. For a malicious act of sabotage, there are, in fact, more accessible targets than spent nuclear fuel, that would provide more spectacular detrimental effects; especially considering the fact that, aside from the radioactivity of the spent nuclear fuel, which is a relatively short range effect, the spent nuclear fuel elements are simply pieces of metal (which might be somewhat warm). In the event of a hijack attempt aimed at some long-term use of the contents of the cask, the communications systems required to be used during the shipment would enable timely notification of authorities who would mobilize response forces. Tracking systems would allow the location of the cask to be determined in real time, thereby aiding in the timely interception of the hijackers by response forces.

The successful completion of attempts aimed at short-term destructive acts, such as explosions from within the cask or inducement of criticality, are not considered credible because they would require sufficient time to breach the cask at a great personal risk to the hijackers (probably lethal exposure), special tooling and techniques, and/or the use of specialized materials (for sufficient moderation) that in themselves are safeguarded materials.

Malicious attack scenarios from a distance, such as the explosion of a bomb near a transportation cask, or an attack by an armor-piercing weapon could be within the realm of possibility. The risk to the health and safety of the public associated with such an event cannot be calculated since there is no basis for estimating either the probability of such an event occurring or that damage sufficient to release radioactive material from the cask would occur. Appendix D, Section D.5.9, provides a discussion of the consequences of some sabotage/terrorist initiated events for the purpose of emergency response planning.

2.9 Preferred Alternative

In selecting a preferred alternative for the management of foreign research reactor spent nuclear fuel, DOE and the Department of State took several factors into consideration, including the following:

1. U.S. Government nuclear weapons nonproliferation policies and objectives;
2. DOE responsibilities (e.g., safe handling of hazardous materials, safety/health risks to workers, compatibility with other ongoing missions, etc.);
3. Potential environmental impacts (e.g., public safety, etc.);
4. Public comments received and concerns expressed following issuance of the Draft EIS;
5. Analysis of impacts and alternatives in the Programmatic SNF&INEL Final EIS (DOE, 1995c), as well as the Record of Decision for that EIS;
6. Estimated costs of alternatives for management of foreign research reactor spent nuclear fuel;
7. Public issues/concerns/perceptions (e.g., fairness/equity to affected States and populations, etc.); and
8. Uncertainties (e.g., future budget priorities and continuity of funding, technology development, repository timing and waste form acceptance criteria, regulatory change, etc.).

Based on consideration of these factors, DOE and the Department of State, in consultation with other Government agencies, designate the alternative described below as the preferred alternative. This preferred alternative is the same as Management Alternative 1 (Manage Foreign Research Reactor Spent Nuclear Fuel in the United States, discussed in Section 2.2), with the modifications discussed below. The basic components of Management Alternative 1 have been modified to incorporate various implementation alternatives discussed in Section 2.2.2.

The amount of foreign research reactor spent nuclear fuel that would be accepted and managed, as specified in Section 2.2.1.3, could total approximately 19.2 MTHM, with a volume of approximately 110 m^3 (4,100 ft^3), representing approximately 22,700 individual spent nuclear fuel elements. The target material that would be accepted and managed, as specified in Section 2.2.2.1, contains an additional 0.6 MTHM representing the uranium content of approximately 620 additional typical foreign research reactor spent nuclear fuel elements. The following stipulations on qualifying spent nuclear fuel types would apply:

- Spent nuclear fuel (HEU and/or LEU) would be accepted from research reactors operating on LEU fuel or in the process of converting to LEU fuel when the policy becomes effective.
- Spent nuclear fuel (HEU and/or LEU) would be accepted from research reactors which operate on HEU fuel when the policy becomes effective and which agree to convert to LEU fuel. Spent nuclear fuel would not be accepted from research reactors that could convert to LEU fuel but refuse to do so.

- Spent nuclear fuel (HEU) would be accepted from research reactors having lifetime cores, from research reactors planning to shut down by a specific date while the policy is in effect, and from research reactors for which a suitable LEU fuel is not available.
- Spent nuclear fuel (HEU and/or LEU) would be accepted from research reactors that are already shut down.
- Unirradiated fuel (HEU and/or LEU) from eligible research reactors would be accepted as spent nuclear fuel.
- For research reactors with both HEU and LEU spent nuclear fuel available for shipment, LEU spent nuclear fuel would not be accepted until the HEU spent nuclear fuel is exhausted, unless there are extenuating circumstances (e.g., deterioration of one or more LEU elements sufficient to cause a safety problem).
- Spent nuclear fuel (HEU and/or LEU) would not be accepted from new research reactors starting operation after the date of implementation of the policy.

The policy duration under this preferred alternative would be 10 years, beginning on the date when the management policy would become effective, as discussed in Section 2.2.1.1. Shipments of spent nuclear fuel to the United States could be made for a period of 13 years, starting from the effective date of policy implementation, as long as the spent nuclear fuel had already been discharged prior to the beginning of the policy period or is discharged during the policy period.

The aluminum-based foreign research reactor spent nuclear fuel would be managed at the Savannah River Site and the TRIGA foreign research reactor spent nuclear fuel would be managed at the Idaho National Engineering Laboratory, in accordance with the Record of Decision for the Programmatic SNF&INEL Final EIS (DOE, 1995c) and the settlement agreement reached between DOE and the State of Idaho [Public Service Co. of Colorado v. Batt, No. CV 91-0035-S-EJL (D. Id.) and United States v. Batt, No. CV-91-0054-S-EJL (D. Id.)]. Under this preferred alternative, up to approximately 19 MTHM of aluminum-based foreign research reactor spent nuclear fuel (approximately 17,800 elements), representing up to approximately 675 casks, and target material representing up to approximately 140 additional casks would be accepted and managed at the Savannah River Site. Also, up to approximately 1 MTHM of TRIGA foreign research reactor spent nuclear fuel (approximately 4,900 elements), representing up to approximately 162 casks would be accepted and managed at the Idaho National Engineering Laboratory.

The candidate U.S. ports of entry are listed in Section 2.2.1.6 and are described in detail in Section 3. Although all of the ports are acceptable based on the port selection criteria discussed in Appendix D, DOE would prefer to candidate use the military ports in proximity to the spent nuclear fuel management sites (i.e., Charleston NWS and the Concord NWS). Under this preferred alternative, a maximum of 38 casks of TRIGA foreign research reactor spent nuclear fuel (estimated to require about 5 shipments) could be accepted at a Western port, with 150 to 300 shipments being accepted via an Eastern port.

The foreign research reactor spent nuclear fuel and target material would be shipped by either chartered or regularly scheduled commercial ships from the foreign ports to the United States, as specified in Section 2.2.1.5.

DOE would take title to the foreign research reactor spent nuclear fuel and target material that is shipped by sea after it is offloaded at the port of entry, and to the spent nuclear fuel and target material shipped solely overland (i.e., from Canada) at the border crossing between Canada and the United States.

The foreign research reactor spent nuclear fuel and target material would be transported from the United States ports to the management sites by truck and rail as specified in Section 2.2.1.7.

The financing arrangement under this preferred alternative would be for the United States to bear the full cost for transporting and managing the foreign research reactor spent nuclear fuel and target material accepted from countries with other-than-high-income economies, and to charge high-income economy countries a competitive fee. The fee would be established in a Federal Register Notice (as opposed to being published in this Final EIS), to allow DOE flexibility to adjust the fee to account for inflation, or changes in spent nuclear fuel management practices in the United States.

For the aluminum-based foreign research reactor spent nuclear fuel, a three point strategy is proposed, as follows:

1. DOE would embark immediately on an accelerated program at the Savannah River Site to identify, develop, and demonstrate one or more non-reprocessing, cost-effective treatment and/or packaging technologies to address potential health and safety issues that may develop and to prepare the foreign research reactor spent nuclear fuel for ultimate disposal. The purpose of any new facilities that might be constructed to implement these technologies would be to change the foreign research reactor spent nuclear fuel into a form that is suitable for geologic disposal, without necessarily separating the fissile materials, while meeting or exceeding all applicable safety and environmental requirements. Examples of technologies that would be considered include: *can-in-canister, chop and dilute/poison, melt and dilute/poison, plasma arc treatment, electrometallurgical treatment, glass material oxidation and dissolution, chloride volatility, dissolve and vitrify, direct disposal in small packages*, etc. Functional schematics of these technologies are shown in Figure 2-21. In conjunction with the examination of new technologies, variations of conventional direct disposal methods would also be explored. After treatment and/or packaging, the foreign research reactor spent nuclear fuel would be managed on site in "road ready" dry storage until transported off-site for continued storage or disposal. DOE would select, develop, and implement, if possible, one or more of these treatment and/or packaging technologies by the year 2000. DOE is committed to avoiding indefinite storage of this spent nuclear fuel in a form that is unsuitable for disposal.

2. Despite DOE's best efforts, it is possible that a new treatment and/or packaging technology may not be ready for implementation by the year 2000. It may become necessary, therefore, for DOE to use the F-Canyon to reprocess some foreign research reactor spent nuclear fuel elements, while the F-Canyon is operating to stabilize at-risk materials as recommended by the Defense Nuclear Facilities Safety Board. (For example, under current schedules this activity could take place between the years 2000 and 2002.) In that event, the foreign research reactor spent nuclear fuel would be converted into LEU and wastes generated during reprocessing. Certain wastes would be vitrified in the Defense Waste Processing Facility, while others would be solidified in the Saltstone facility. In order to provide a sound policy basis for making a determination on whether and how to utilize the F-Canyon for processing tasks that are not driven by health and safety considerations, DOE will commission or conduct an independent study of the nonproliferation and other (e.g., cost and timing) implications of reprocessing spent nuclear fuel from foreign research reactors. The study will be initiated in mid-1996 and will be completed in a timely fashion to allow a subsequent decision about possible use of the F-Canyon for foreign research reactor spent nuclear fuel reprocessing to be fully considered by the public, the Congress and the Executive Branch agencies. Pending disposition of the foreign research reactor spent

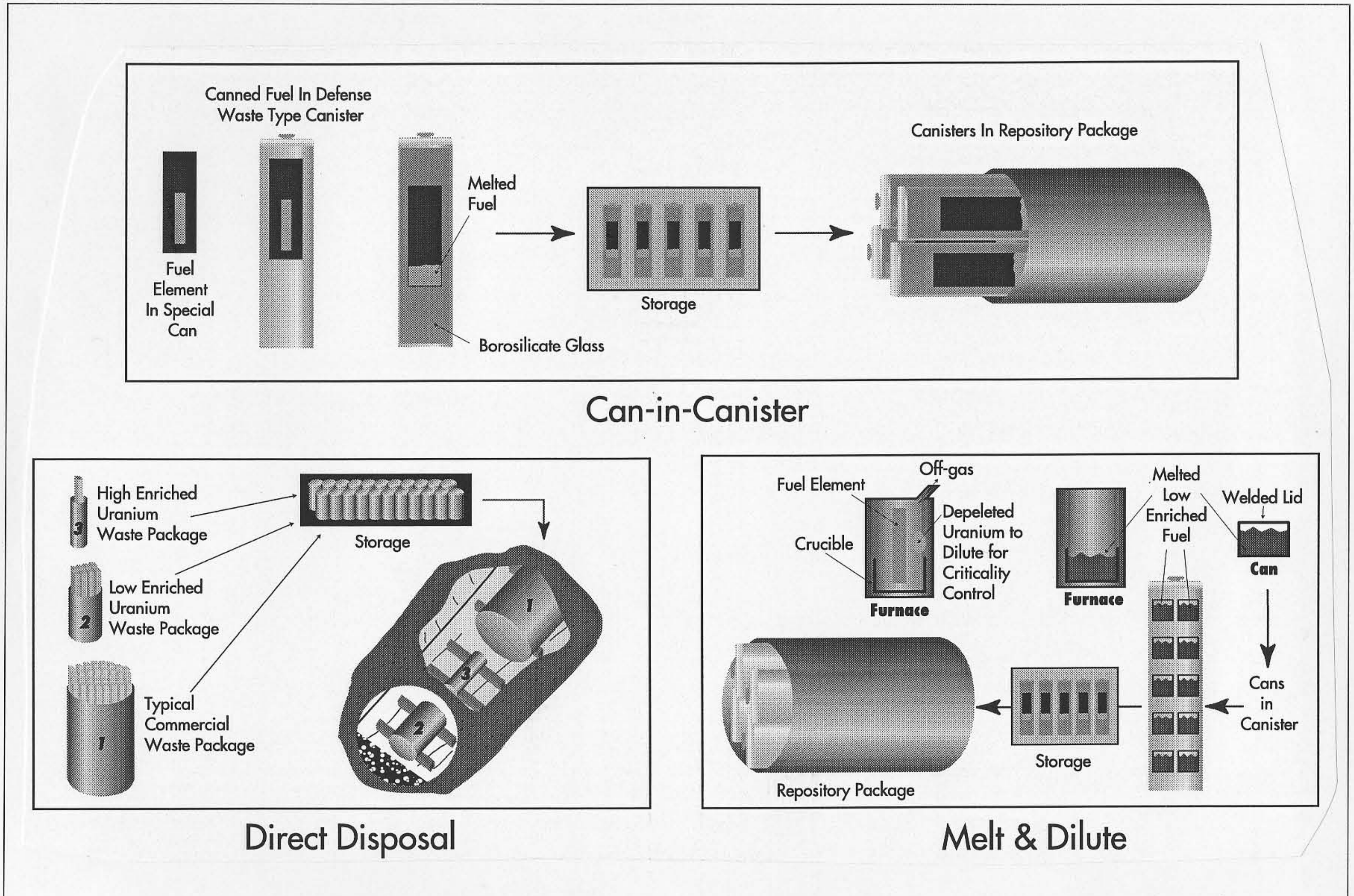


Figure 2-21 New Treatment and Packaging Technologies (Functional Schematic Diagrams)

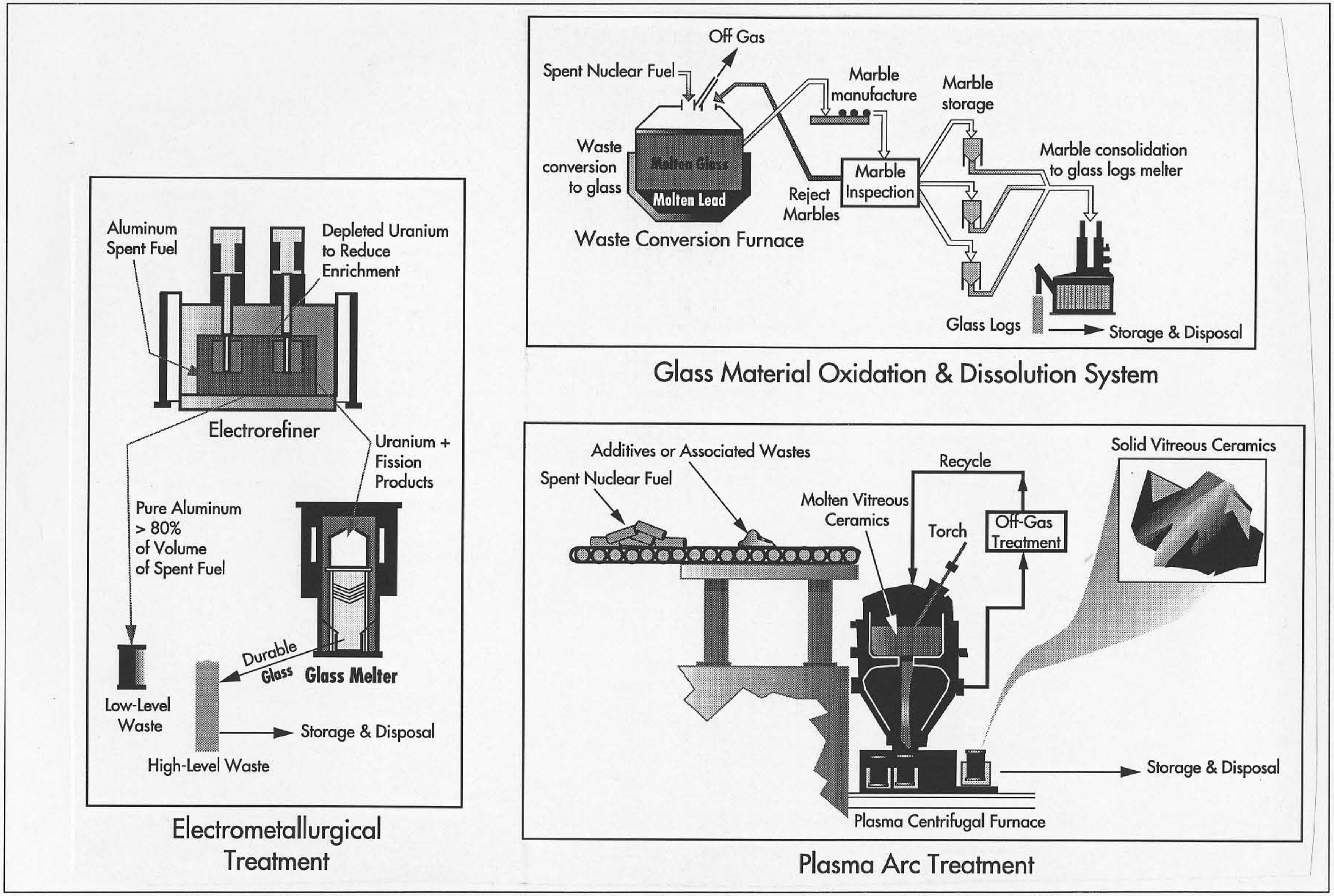


Figure 2-21 New Treatment and Packaging Technologies (Functional Schematic Diagrams) (Continued)

nuclear fuel by either a new treatment and/or packaging technology or reprocessing in the F-Canyon, the spent nuclear fuel would be placed in existing wet storage at the Savannah River Site.

3. DOE would conduct a program of close monitoring of any foreign research reactor spent nuclear fuel and target material that would be accepted for storage in existing wet storage facilities. DOE is presently unaware of any technical basis for believing that this spent nuclear fuel cannot be safely stored until one or more of the treatment and/or packaging technologies becomes available. Nevertheless, if health and safety concerns involving any of the foreign research reactor spent nuclear fuel elements are identified prior to development of an appropriate treatment and/or packaging technology, DOE would use the F-Canyon to reprocess the affected spent nuclear fuel elements, if it is still operating to stabilize at-risk materials.

   Because of criticality constraints stemming from the configuration of the F-Canyon, under no circumstances would it be possible to produce separated HEU that is suitable for a nuclear weapon. Instead, depleted uranium would be added to the foreign research reactor spent nuclear fuel near the beginning of the reprocessing process, so that only LEU would be produced when the uranium is separated from the fission products. The trace quantities of plutonium in the spent nuclear fuel would be left in and solidified along with the high-level radioactive reprocessing wastes. This would further the President's policy to discourage the accumulation of excess weapons grade fissile materials, to strengthen controls and constraints on these materials and, over time, to reduce worldwide stocks.

The TRIGA foreign research reactor spent nuclear fuel would be stored at the Idaho National Engineering Laboratory in the Fluorinel Dissolution and Fuel Storage (FAST) facility (wet storage) or preferably the dry storage Irradiated Fuel Storage Facility (IFSF) and the CPP-749 dry storage area. After 2003, all foreign research reactor spent nuclear fuel would be managed in accordance with the provisions of the settlement agreement between DOE and the State of Idaho, until transported off-site for ultimate disposition. Depending on the nature of any new treatment and/or packaging technology that might be developed, the TRIGA spent nuclear fuel would also be processed using such a new technology, if necessary for disposal.

A critical result of implementing this preferred alternative would be the continued viability and vitality of the Reduced Enrichment for Research and Test Reactors (RERTR) Program, whose goal is minimizing and eventually eliminating the use of HEU in civil nuclear programs, by providing foreign research reactor operators with a continued incentive to participate. Similarly, the successful development of alternative fuels for research reactors and the expansion of the program to Russia, the other Newly Independent States, China, South Africa, and other countries, and the establishment of a world-wide norm discouraging the use of HEU, are dependent on the United States' commitment to action such as that embodied in this preferred alternative.

DOE is aware that the inclusion of chemical separation within the preferred alternative could be interpreted by some nations, organizations and persons as a signal of endorsement of the use of reprocessing as a routine method of waste management for spent nuclear fuel or a reversal of U.S. policy on reprocessing. This would not be an accurate interpretation. The U.S. policy regarding reprocessing was established in Presidential Decision Directive 13. DOE and the Department of State have determined that this preferred alternative is not inconsistent with that policy. The draft version of this EIS indicated that reprocessing is a non-preferred technology and would not be used unless one or more of a set of specific conditions occurred (see Draft EIS Section 2.2.2.6). This final preferred alternative, which includes reprocessing, establishes a prescribed set of circumstances that would have to be met before reprocessing would be used. The independent study discussed above in point 2 of the strategy for management of aluminum-based spent nuclear fuel will review the policy, technology, cost and schedule implications for reprocessing foreign research reactor spent nuclear fuel to determine whether reprocessing of foreign research reactor spent nuclear fuel is justified for other than health and safety reasons.

Policy considerations and environmental impacts associated with implementation of this preferred alternative are presented in Section 4.7. Cost considerations are included in Section 4.9.

Basis for the Preferred Alternative - The elements of the preferred alternative discussed above have been selected based on the following considerations:

1. ***Management Alternative*** - The various management alternatives considered are discussed in Sections 2.2 through 2.4 of the EIS. The analyses in Sections 4.2 through 4.5 of the EIS demonstrate that the impacts on the environment, involved workers, or the citizens of the United States from implementation of any of the management alternatives or implementation alternatives analyzed (other than beneficial impacts associated with support for United States nuclear weapons nonproliferation policy) would be small and completely within the applicable regulatory limits, and would not provide a basis for discrimination among the alternatives. As a result, the process for selection of the elements of the preferred alternative focused on programmatic considerations:

    a. DOE and the Department of State concluded that the No Action Alternative and Management Alternative 2, Implementation Alternative 1a (Overseas Storage) would be unacceptable since these alternatives are not consistent with United States nuclear weapons nonproliferation policy objectives.

    b. DOE and the Department of State believe that the basic implementation of Management Alternative 1 would be undesirable to the extent that it would involve indefinite storage of foreign research reactor spent nuclear fuel in a form that is not suitable for disposal. Management Alternative 1 modified to rely solely on Implementation Alternative 6 (Near Term Conventional Chemical Separation in the United States) would raise nuclear weapons nonproliferation policy questions. Management Alternative 1 modified to rely solely on Implementation Alternative 7 (Developmental Treatment and/or Packaging Technologies) could not be selected at this time because no decision has been made on which technology will be pursued.

    c. DOE and the Department of State also believe that Management Alternative 2, Implementation Alternative 1b (Overseas Reprocessing) would be technically complex and potentially extremely expensive because it would require the United States to accept reprocessing wastes from the overseas reprocessing operations. This is due to the fact that both of the countries in which the overseas reprocessing might be accomplished require the reprocessing wastes to leave their countries, and many of the countries that would be covered by the proposed policy cannot accept the return of such reprocessing wastes. The intermediate-level radioactive wastes produced in Europe during reprocessing of research reactor spent nuclear fuel are often in a concreted waste form, unlike any high-level radioactive waste form in the United States. This concreted waste form has not been evaluated for disposal in a United

States geologic repository. Accordingly, acceptance of such waste in the United States likely could require expensive, currently unproven treatment and/or packaging technologies to transform it into a form that would be acceptable for disposal.

d. The sample hybrid alternative (Management Alternative 3) analyzed in the Draft EIS involved partial reprocessing overseas coupled with partial management in the United States. In order for this alternative to be consistent with United States nuclear weapons nonproliferation policy objectives, certain conditions would have to be met by either the reprocessor (e.g., Dounreay) or the research reactor operators. Staff from both DOE and the Department of State have addressed this issue with representatives of the United Kingdom Department of Trade and Industry and reactor operators, and have determined that it would not be possible to ensure compliance with the United States nuclear weapons nonproliferation policy objectives. The primary concern was the inability to ensure that any separated HEU would be blended down to LEU. Obtaining the reactor operators' agreement to such a policy would likely require significant financial subsidies. The potential cost of achieving agreement to blend down the uranium, plus uncertainties regarding Dounreay's long-term availability, led DOE and the Department of State to conclude that successful implementation of this alternative could not be relied on.

None of the alternatives analyzed in the Draft EIS could be implemented without some degree of difficulty. However, a modification of Management Alternative 1 (Manage Foreign Research Reactor Spent Nuclear Fuel in the United States), incorporating a combination of alternatives to the basic implementation components balances policy, technical, cost and schedule requirements. DOE and the Department of State consider that this approach provides the highest assurance that programmatic requirements could be met. This combination also provides the strongest support for United States nuclear weapons nonproliferation policy objectives as all aspects of the alternative would be under the control of DOE, either directly or through the spent nuclear fuel acceptance contracts with the reactor operators.

2. ***Management Technology*** - The alternative spent nuclear fuel management technologies considered are discussed in Sections 2.2.2.7 and 2.6.5 of the EIS. The approaches fall into four broad categories, as follows:

Wet Storage - Wet storage is a proven technology, the impacts of which would be small, and completely within the applicable regulatory limits, if it were used to implement the proposed action. Furthermore, DOE currently has wet storage facilities in operation at the Savannah River Site and the Idaho National Engineering Laboratory that could be used for storage of foreign research reactor spent nuclear fuel. However, wet storage requires attention to ensure that the storage conditions do not foster slow degradation of the spent nuclear fuel through corrosion.

Dry Storage - Dry storage is also a proven technology, that would also have no more than small impacts, completely within the applicable regulatory limits, if used to implement the proposed action. It is the storage medium that is being selected at all commercial power reactor sites where additional storage capacity is being built. However, it has not been used for research reactor spent nuclear fuel in the United States. Dry storage capacity could be provided at the management sites in time to meet the program's projected needs, if initial spent nuclear fuel receipts were placed into the available wet storage.

Chemical Separation - Chemical separation is also a proven technology, the impacts of which would be small, and completely within the applicable regulatory limits, if used to implement the proposed action. However, DOE is phasing out its chemical separation activities and is currently reprocessing only at the Savannah River Site to stabilize materials for health and safety reasons. Because these chemical separations facilities could be used to treat the foreign research reactor spent nuclear fuel, they provide a contingency to be considered pending availability of an alternate means of treating and/or packaging the spent nuclear fuel prior to ultimate disposition.

New Technologies - Due to concerns regarding geologic disposal of intact spent fuel containing HEU (i.e., the possibility of uncontrolled criticality incidents), some form of treatment of this spent nuclear fuel may be required. While several concepts have been proposed for new treatment and/or packaging technologies, none of them are ready for implementation at this time. Prior to a decision leading to their implementation, additional development work would be required to determine whether and how they could be implemented, based on technical and cost considerations.

In order to effectively implement the preferred alternative of accepting and managing the foreign research reactor spent nuclear fuel in the United States, DOE and the Department of State developed the three point strategy for management of aluminum-based spent nuclear fuel discussed earlier in this Section. This strategy draws on the strengths of each of the spent nuclear fuel management technologies discussed above, while avoiding sole reliance on any of them. Due to the relatively more robust nature of the TRIGA spent nuclear fuel, DOE believes that minimal additional development may be needed to prepare it for storage and final disposition. Accordingly, the preferred alternative specifies that the TRIGA spent nuclear fuel would be placed in existing dry storage facilities at the Idaho National Engineering Laboratory. However, the program to qualify the final geologic disposal form for the TRIGA spent nuclear fuel will continue and the appropriate treatment, if any, would be identified and implemented.

3. ***Policy Duration*** - The alternative policy durations considered are defined in Sections 2.2.2.1 and 2.2.2.2 of the EIS. Analysis of these alternatives concluded that the 5-year option is likely to provide insufficient time for the reactor operators to arrange for alternative spent nuclear fuel disposal mechanisms, and thus might result in some reactor operators refusing to cooperate fully with United States nuclear weapons nonproliferation programs. This, in turn, could undermine international cooperation with other nuclear weapons nonproliferation programs the United States might seek to implement.

   On the other hand, the analysis determined that there was insufficient benefit to be gained from indefinite acceptance of all of the spent nuclear fuel containing HEU because such an approach likely would provide insufficient incentive for other countries to proceed expeditiously with arrangements for alternative disposal mechanisms not involving the United States.

   The approach incorporated into the preferred alternative allows sufficient incentive to the reactor operators to ensure their cooperation, while specifying a definite cut-off point. This alternative provides sufficient lead time to allow the reactor operators to make other arrangements for disposition of their spent nuclear fuel, and provides sufficient time to accept all spent nuclear fuel containing HEU enriched in the United States.

4. ***Amount of Material to Manage*** - The alternative amounts of material that might be covered by the proposed policy are defined in Sections 2.2.1.3 and 2.2.2.1 of the EIS. DOE and the Department of State concluded that management of spent nuclear fuel only from other-than-high-income economy countries would strongly encourage the resurgence of the use of HEU in the high-income economy countries, as well as opening the United States, fairly or unfairly, to charges that we are not living up to our commitments under the *Treaty on the Non-Proliferation of Nuclear Weapons*. Management of only spent nuclear fuel containing HEU would penalize those reactors that have already converted to the use of LEU fuel, and would provide an incentive for reactors to continue to use HEU fuel, or switch back to its use. The impacts that would result from management of any of these different amounts of material would be small, and within the applicable regulatory limits.

   DOE and the Department of State concluded that management of all of the aluminum-based and TRIGA foreign research reactor spent nuclear fuel currently in storage or projected to be discharged during the policy period, and target material containing uranium enriched in the United States, would provide the best support for the objectives of the proposed policy. Implementation of this preferred alternative would provide an opportunity for removal of the maximum amount of HEU from civil commerce and would provide an incentive for the continued conversion to and use of LEU as fuel for foreign research reactors, in place of highly enriched (weapons grade) uranium.

5. ***Marine Transport*** - The alternative approaches to marine transport of foreign research reactor spent nuclear fuel are discussed in Section 2.2.1.5 of the EIS. The analysis in the EIS demonstrates that the impacts to the environment, workers or the public from transport of the spent nuclear fuel using any of these types of ships would be small, and within the regulatory limits. The analyses do not identify any difference in the small impacts that would result from the use of purpose-built vs. general purpose ships. Since "military transports" are in fact the same type of ship as the chartered commercial cargo ships and are crewed by civilians, use of "military transports" would not actually result in any difference in impacts. DOE and the Department of State believe that use of actual warships would be both unnecessary from a security standpoint and could entail additional risk to the environment and the public, since such ships do not routinely carry cargo.

   The approach selected by DOE and the Department of State for the preferred alternative provides maximum flexibility for marine transport.

6. ***Ground Transport*** - The ground transportation alternatives are defined in Section 2.2.1.7 of the EIS. The analyses in the EIS demonstrate that the impacts to the environment, workers or the public, from any of these modes of ground transport (counting barge as a mode of "ground transport") would be small and within the applicable regulatory limits. Furthermore, the differences in potential impacts between the truck, rail and barge alternatives were not significant.

   Both the truck and rail transportation options have been used successfully to transport foreign research reactor spent nuclear fuel in the past. Truck transport was the predominant mode used for over twenty years, until the old "Off-Site Fuels Policy" lapsed in 1988. Rail was the mode used for both shipments under the *Environmental Assessment of Urgent-Relief Acceptance of Foreign Research Reactor Spent Nuclear Fuel* (DOE, 1994m). Since neither of the preferred ports of entry (see item 8 below) can reasonably provide barge transport to either of the proposed management sites, barge transport was dismissed from consideration in the preferred alternative.

By providing for either truck or rail transport, the preferred alternative would build on previous satisfactory experience while providing maximum flexibility for dealing with changes in the transportation process in the future.

7. ***Title Transfer Location*** - The alternative points at which DOE might take title to the spent nuclear fuel and target material are discussed in Sections 2.2.1.4 and 2.2.2.4 of the EIS. The point at which title would be transferred has no effect on the physical processes that would take place, and thus would not have any effect on the impacts on the environment, workers or on the public. The Price-Anderson Act would provide liability protection in the unlikely event of a nuclear accident in the United States, whether or not DOE had taken title to the spent nuclear fuel at the time of such an accident. As a result, DOE and the Department of State concluded that the selection of the title transfer location could be made solely on programmatic considerations.

   Acceptance of title at the foreign research reactor sites could make the United States Government liable for any accident that might occur in the country of origin, or on the high seas. DOE and the Department of State have been unable to identify any advantage to the United States of taking title outside the United States.

   Taking title at the limit of United States territorial waters makes the title transfer depend solely on when the ship enters United States waters, which could be difficult for DOE to control in certain circumstances (e.g., a storm).

   Acceptance of title when the foreign research reactor spent nuclear fuel actually enters the land mass of the United States provides the most certainty for implementation.

   The approach incorporated into the preferred alternative ensures that liability for accidents during the transportation process outside the United States would remain with the reactor operators while reinforcing in the minds of the public that the United States Government would be accountable in the unlikely event of an accident within United States territory.

8. ***Ports of Entry*** - The alternative ports of entry considered are discussed in Sections 2.2.1.6 and 3.2 of the EIS. The analyses in the EIS demonstrate that the impacts on either the environment, workers or the public due to use of any of the potential ports of entry analyzed would be small and within applicable regulatory limits.

   Although any one or all of the ten ports of entry described in Sections 2.2.1.6 and 3.2 of this EIS would be acceptable ports of entry, DOE and the Department of State concluded that foreign research reactor spent nuclear fuel marine shipments to the United States should be made via the military ports (selected from among those analyzed in the EIS and found acceptable) in close proximity to the spent nuclear fuel management sites. DOE would seek to transport multiple casks per ship to keep the total number of shipments as low as possible, as well as to reduce risks. The exact number of shipments that might be made would be determined by several factors that are unknown at this time, such as the times at which the reactor operators need to make shipments over the 13 year shipping period, the geographic distribution of the reactors, and the availability of suitable ships that would stop at the required ports to pick up and drop off the spent nuclear fuel and target material.

Use of military ports would provide additional confidence in the safety of the shipments due to the increased security associated with the military ports. It could also require much of the spent nuclear fuel to be shipped via chartered ships since commercial ships would not have stops scheduled at military ports, increasing the cost of spent nuclear fuel shipping. This additional cost would be borne by the reactor operators for shipments from high-income economy countries, and by the United States for shipments from other-than-high-income economy countries. Additional costs would be kept to a minimum by shipping as many casks as possible on each ship (up to a maximum of 8 per ship).

9. ***Management Sites*** - The question of which sites should be used for management of all of DOE's spent nuclear fuel was addressed in the Programmatic SNF&INEL Final EIS (DOE, 1995c). That EIS included consideration of the potential receipt of the foreign research reactor spent nuclear fuel. The Record of Decision for that EIS, issued on May 30, 1995, specifies that any aluminum-based foreign research reactor spent nuclear fuel accepted in the United States shall be managed at the Savannah River Site; and that the remaining foreign research reactor spent nuclear fuel shall be managed at the Idaho National Engineering Laboratory. The site for management of the target material was left to be decided under this EIS. All of the target material currently in DOE's possession is managed at the Savannah River Site. The approach incorporated into the preferred alternative is in compliance with the decision specified in the Record of Decision for the Programmatic SNF&INEL Final EIS.

   The analyses in the EIS demonstrate that the impacts to either the environment or the public through use of any of the sites for management of the foreign research reactor spent nuclear fuel and target material would be small, and within the applicable regulatory limits.

10. ***Financing Arrangement*** - The alternative financing arrangements are discussed in Sections 2.2.1.2 and 2.2.2.3 of the EIS. The financing arrangement used for the proposed action would have no effect on the physical processes that would take place, and thus would not have any effect on the potential impacts on the environment, or on the public. However, it could affect how many foreign research reactor operators elect to ship spent nuclear fuel to the United States. For instance, if DOE and the Department of State chose to charge a full cost recovery fee to all reactors, many, if not all, of the reactors in other-than-high-income economy countries would not have the financial resources to participate. On the other hand, if the United States subsidized all of the reactors, the United States would bear the full financial burden, even for reactors which can afford to pay their fair share.

    DOE and the Department of State concluded that, to ensure that reactor operators in other-than-high-income economy countries would participate in the program, the United States should subsidize receipt of their spent nuclear fuel. DOE and the Department of State also concluded that DOE should strive to recover as much of the cost of managing the spent nuclear fuel as possible from high-income economy countries. DOE concluded that it would announce the fee in a *Federal Register* notice, so that the fee may be changed from time to time as necessary to reflect inflation or improvements in DOE's knowledge concerning the costs of the activities to be carried out.

    Such an approach would encourage participation by as many other-than-high-income economy countries as possible, would recover as much as possible of the United States' expenses for management of spent nuclear fuel from high-income economy countries without encouraging any of them to resort to reprocessing of their spent nuclear fuel, and would provide a mechanism through which to account for inflation and future definition of program details.

2.10 Additional Alternatives Considered But Dismissed

Besides ocean transport by vessel, carriage by air is the only other mode of transportation from overseas nations to the United States. There are two distinct reasons why the air mode is not a feasible alternative to the sea mode for transportation of foreign research reactor spent nuclear fuel.

First, with the possible exception of small sample quantities, spent nuclear fuel is required to be transported in packagings (casks) weighing several tons. As a general rule, casks would have to be shipped singly by air (i.e., one per airplane) because of their weight. This has made the air alternative so costly as to be prohibitive. As a result, there is no commercial operational experience in the United States with air transport of spent nuclear fuel. No "Standard Operating Procedures" have been written and no intermodal transfer procedures (air-truck or air-rail) have been developed. No agreements have been negotiated regarding airspace overflight of other nations or states. Because the United States has no experience with this type of transportation, no meaningful comparison can be made between air transport and ship transport regarding either incident-free doses to workers and the public or accident risks.

Second, plutonium air transport packaging standards clearly apply to movement by air of any non-exceptional package containing more than 0.005 curies of plutonium (10 CFR 71.88a). The foreign research reactor spent nuclear fuel considered in this EIS is non-excepted and could contain more than 0.005 curies of plutonium per cask. Therefore, the spent nuclear fuel would have to be transported in a cask meeting plutonium air transport packaging standards. Because no spent nuclear fuel transportation cask has been certified to meet plutonium air transport packaging standards, transporting foreign research reactor spent nuclear fuel by air to the United States could not be accomplished in the near term.

The following additional considerations contributed to the dismissal of air transport as an alternative transportation mode of foreign research reactor spent nuclear fuel: 1) Most United States airports lack rail connections; therefore ground transportation would be limited to the use of trucks; 2) airports have no experience in handling spent nuclear fuel and the capabilities of the available handling equipment are marginal and; 3) worker exposure associated with handling activities would be higher because a lack of automation in handling equipment.

The alternative of accepting of foreign research reactor spent nuclear fuel only from countries that present a potential nuclear weapons proliferation risk was considered but dismissed. A major drawback inherent in this alternative is that potential proliferant countries might well object to being publicly identified as such and, on one pretext or another, refuse to cooperate with the United States in the program. Further, this alternative would not address the potential that some countries that are not currently identified as nuclear weapons proliferation threats might become such a threat in the future. To account for acceptance of foreign research reactor spent nuclear fuel from such countries, DOE would have to assume and analyze one or more "hypothetical reactors" to estimate the potential environmental impacts. The public noted its objection to such an approach when DOE proposed to accept 150 foreign research reactor spent nuclear fuel elements from one or more unnamed "hypothetical reactors" in the first draft of the *Environmental Assessment of Urgent-Relief Acceptance of Foreign Research Reactor Spent Nuclear Fuel* (DOE, 1994m). Finally, implementation of such an alternative would leave unresolved the spent nuclear fuel disposition concerns of the majority of the countries in which foreign research reactors are operating. These countries would be likely to argue, rightly or wrongly, that the United States was not living up to its obligations under the *Treaty on the Non-Proliferation of Nuclear Weapons* to assist nonnuclear weapon states with the peaceful application of nuclear energy. This would damage the credibility of the United States as a reliable partner in the implementation of international nuclear materials management. In consideration of the above summarized flaws, DOE dismissed this alternative from consideration in this EIS.

As a result of public comments, the possibility of managing foreign research reactor spent nuclear fuel on an isolated island was considered, and dismissed. A new facility on an island could not be ready to receive foreign research reactor spent nuclear fuel for at least five years, necessitating temporary management at another location (Savannah River site or Idaho National Engineering Laboratory) for at least the first half of the policy period. Furthermore, management of spent nuclear fuel on such an island is undesirable from the standpoint of security and safety. Provision of physical security would be much more difficult on a remote island than at a mainland site, due to isolation and the greater challenges of protecting open coastlines. Small isolated islands are subject to a greater frequency of severe weather than occurs in the mainland, and after a severe storm it can be more difficult to restore services than it would be in a mainland area.